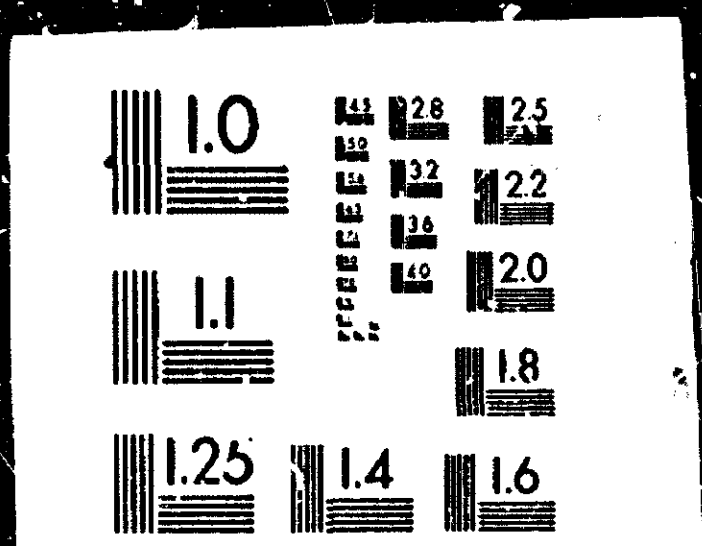


PB82-123985

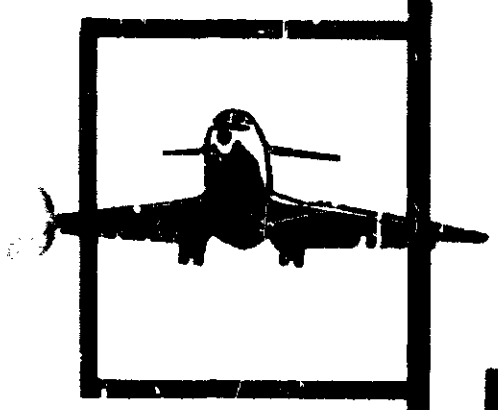
Special Investigation Report
Aircraft Separation Incidents at Hartsfield
Atlanta International Airport, Atlanta, Georgia
October 7, 1980

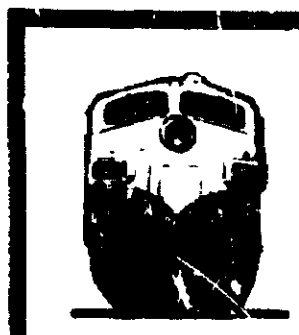
(U.S.) National Transportation Safety Board
Washington, DC

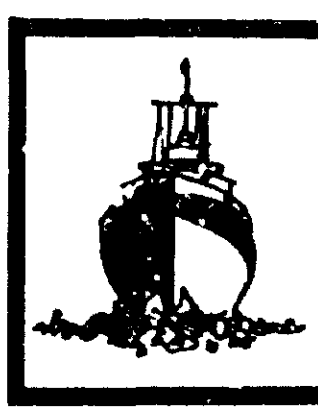
24 Sep 81

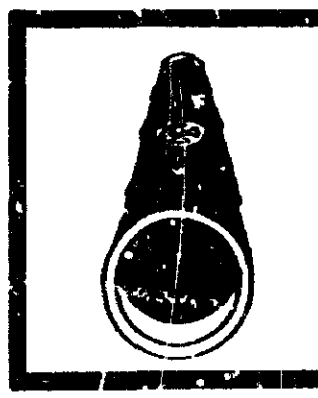
U.S. Department of Commerce
National Technical Information Service
NTIS.

PB82-123985









NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

SPECIAL INVESTIGATION REPORT

AIRCRAFT SEPARATION INCIDENTS AT HARTSFIELD ATLANTA INTERNATIONAL AIRPORT ATLANTA, GEORGIA OCTOBER 7, 1980

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Between 8:15 and 8:21 a.m., eastern standard time, on October 7, 1980, under clear skies with 15-mile visibility, a chain of events occurred in which several aircraft, operating under the direction of air traffic control in the vicinity of the Hartsfield International Airport, Atlanta, Georgia, were inadvertently placed in positions which infringed upon normal separation standards. Five aircraft were involved, some in repetitive conflict situations. In at least two encounters, the pilots of air carrier aircraft found it necessary to take evasive action to avoid a collision. The pilot of one aircraft increased power so quickly that the maximum exhaust gas temperature limits of all three of the aircraft's engines were exceeded.

The National Transportation Safety Board's investigation reconstructed the events and reviewed the air traffic control procedures involved. Based on its investigation, the Safety Board concludes that similar circumstances could arise at any approach facility where the procedures and radar control equipment are similar to those at the Atlanta facility. This report discusses these circumstances, emphasizing those areas which need attention, and describes a unique investigative technique involving the reduction and analysis of data extracted from an air traffic control radar system computer, which should prove useful in future investigations involving air traffic control issues.

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

SPECIAL INVESTIGATION REPORT

Adopted: September 24, 1981

AIRCRAFT SEPARATION INCIDENTS AT HARTSFIELD ATLANTA INTERNATIONAL AIRPORT ATLANTA, GEORGIA OCTOBER 7, 1980

INTRODUCTION

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INVESTIGATION

The Hartsfield Atlanta International Airport Environment

In 1980, the Hartsfield Atlanta International Airport was the second busiest airport in the United States. It served 41 million passengers and handled 225,000 metric tons of cargo. The terminal complex is the world's largest with a 55-million passenger-per-year capacity. Over 100 air traffic controllers were employed by the Federal Aviation Administration (FAA) to work at the Atlanta Tower (which includes Atlanta Approach Control). Controllers provide air traffic control services to aircraft arriving and departing the Atlanta airport. In terminal areas, such as Atlanta where the traffic density is high, a Terminal Control Area (TCA) is designated in which all aircraft movements are under "positive" control. 1/ Designated airspace within a 40-nautical mile (nmi) radius of the airport is divided into segments which are defined by both geographical and altitude boundaries and are designed in accordance with the direction of traffic flow. Each segment is assigned to a controller who is responsible for providing air traffic

1/ Positive control--the separation of all air traffic, within designated airspace, by air traffic control.

control services, one of which is to assure that the standard separation of 3 nmi horizontally, or 1,000 feet vertically, is maintained between aircraft transiting the airspace. To maintain standard separation, the controller relies on the video display of traffic and associated data blocks generated by an automated radar terminal system (ARTS III). The ARTS III augments the basic radar display with computer-generated symbols and alphanumeric characters depicting flight identification, aircraft altitude, groundspeed, and flight plan data. In addition, the system incorporates a "conflict alert" feature designed to provide both an audio and visual alert to the controller whenever aircraft will have less than acceptable separation.

Control of Arrival Traffic

The controllers at the Atlanta tower operated in a "team" or "crew" concept; each team had sufficient personnel to man a given complement of positions in the tower cab or the radar room. The tower cab positions included ground control, local control, and flight data, and the radar room positions included the control and handoff function for each sector, for example, north feeder, south feeder, north final, south final, monitor, and satellite. There were 14 teams of controllers who rotated between shifts and between the various Atlanta tower positions.

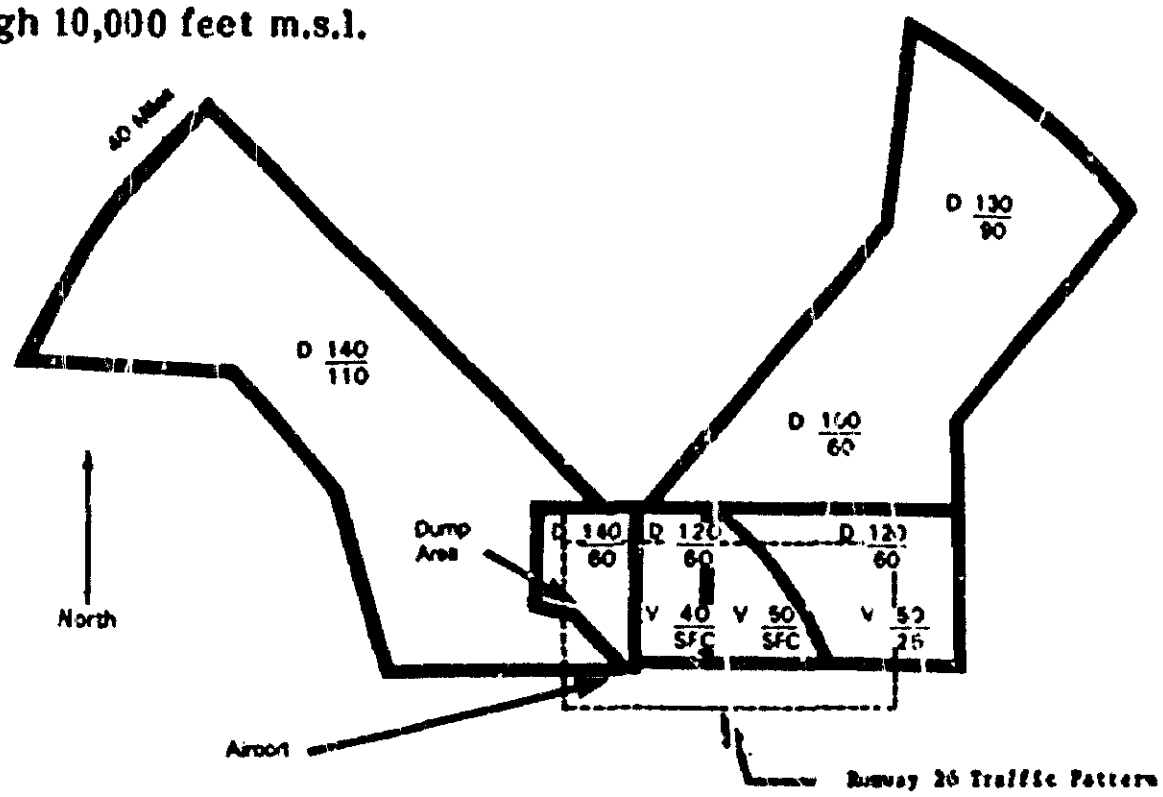
When an aircraft approaches the Atlanta terminal area, it is normally under the control of the en route air route traffic control center. The en route controller will "hand off" the traffic to a feeder controller before the aircraft approaches or enters the boundary of the terminal area. The handoff is an action taken to transfer the radar identification of an aircraft from one controller to another. This action is automated with the ARTS III equipment so that the aircraft's target will automatically appear on the feeder controller's video display and will be identified by intermittent flashing of the target data tag. Responsibility for the aircraft is usually transferred at the time of handoff, but it may be transferred at any specific time or altitude agreed upon between the controllers. The receiving controller must positively acknowledge the handoff by a keyboard action at his console position, after which the data tag continues to be depicted but ceases to flash.

In the Atlanta terminal area, a "feeder" controller generally receives inbound instrument flight rules (IFR) traffic at an altitude of 13,000 feet from the Atlanta Center controller. The feeder controller is responsible for providing radar service and separation for both IFR traffic and traffic arriving under visual flight rules (VFR). The feeder controller must sequence both the IFR and VFR traffic into an orderly flow as it transits his sector in preparation for a handoff to a final controller. The final controller is responsible for controlling traffic close to the airport; he sequences and positions the traffic for the final approach before turning the aircraft over to the tower for landing clearance. The handoff between the feeder controller and the final controller is automated and generally occurs while the aircraft is descending to an altitude of 6,000 or 7,000 feet, some distance before the boundary. The actual area of responsibility for the north feeder controller and the final controller--the two controllers involved in the incident--is shown on figure 1.

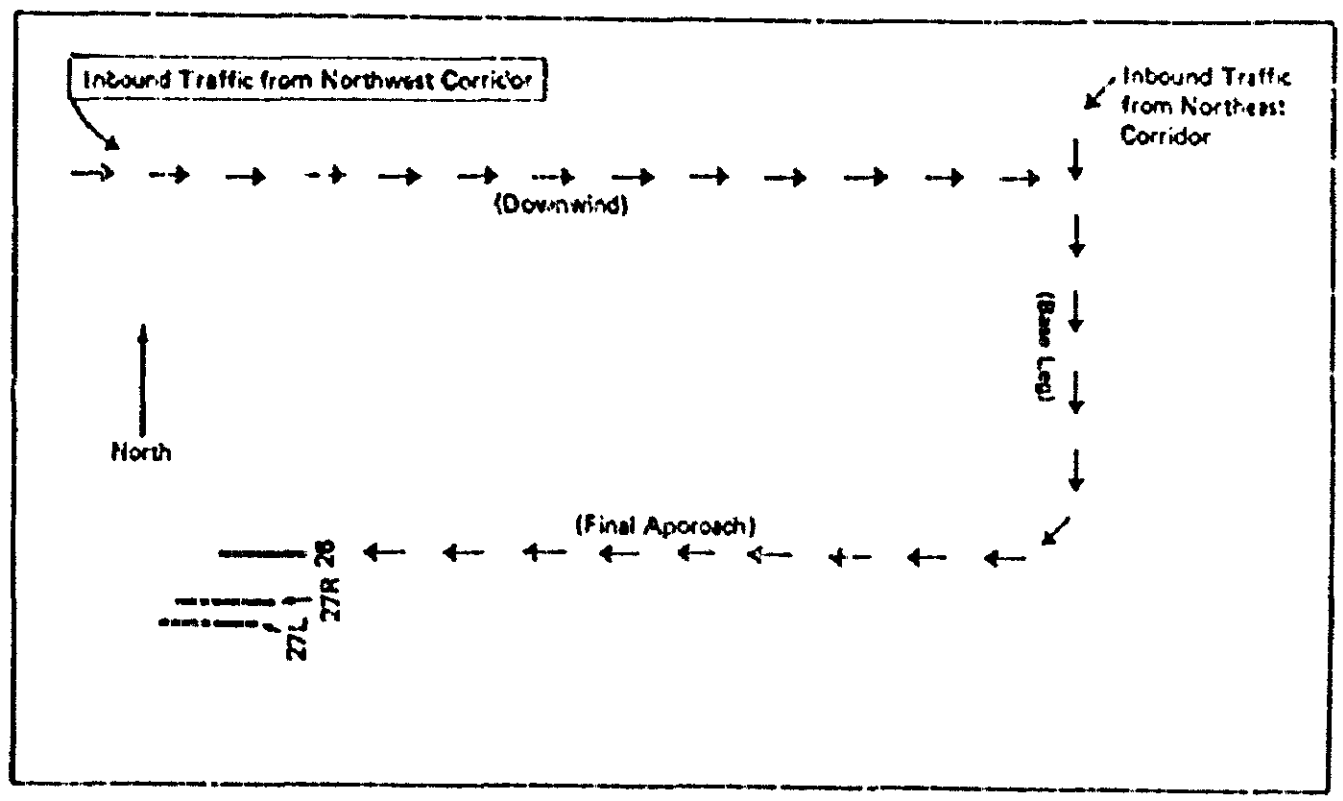
Each controller can manually select traffic which will be displayed on his video presentation. Normally, all traffic approaching or within a controller's airspace segment for which he has positively acknowledged acceptance for control responsibility will be displayed. When control is relinquished to the next controller, the display of that aircraft can be deleted; thus, the feeder controller may not observe traffic handed off to the final controller. Also, the final controller may not observe traffic remaining under the control of the feeder controller if the automatic handoff was inhibited.

HARTSFIELD ATLANTA INTERNATIONAL AIRPORT

The north terminal arrival (feeder) controller is responsible for the airspace designated "D" and the airspace for which the north final controller (final) is responsible is designated "V." D $\frac{100}{60}$ means the feeder controller is responsible for the control of all traffic from 6,000 through 10,000 feet m.s.l.



North Arrival Airspace



Runway 26 Traffic Pattern

Figure 1.--Boundaries of responsibility of north feeder controller and final controller.

The north feeder controller actually works two corridors of inbound traffic. One corridor originates northwest of the airport, and the other corridor originates northeast of the airport. Both corridors meet about 7 miles north of the airport. Atlanta had no specific procedures in effect stating how the converging traffic from the two corridors should be handled. The procedure generally used by the crew on duty October 7 was for the final controller, following handoff, to assume responsibility for assuring separation between aircraft arriving from both corridors. During its investigation, the Safety Board learned that some crews stop their downwind traffic (from the northwestern corridor) at 7,000 feet and have the base leg traffic (from the north-eastern corridor) at 6,000 feet, thus providing vertical separation until the final controller can establish sequencing horizontally.

Although the feeder and final controllers are located in the same control room, their positions are physically located so that direct voice communication is not possible; they can communicate verbally with one another through an intercommunication system. Controllers communicate with the aircraft for which they are responsible on separate frequencies. After handoff is accomplished, therefore, the pilot must change radio frequencies. Consequently, the various controllers do not hear their fellow controllers' radio communications.

Events of October 7, 1980

The Safety Board reconstructed the chain of events on the morning of October 7, 1980, by the reduction and analysis of data extracted from the ARTS-III computer, the air traffic control air-to-ground communication recordings, and interviews with air traffic control personnel and pilots involved. The events involved aircraft that were inbound to the airport through airspace for which the north feeder controller and the north final controller were responsible.

Shortly before 8:09 a.m., the weather was clear and visibility was 15 miles. The feeder controller was accepting traffic from the en route center controller at regular intervals and was providing air traffic control services to those aircraft which were transiting his area. Four aircraft were approaching positions where they would be normally handed off to the final controller. About the same time, the final controller was controlling five aircraft, three inbound air carriers from the north and two inbound general aviation from the south. The final controller was attempting to position the aircraft by issuing radar vectors and altitude assignments for a sequenced flow into the downwind, base, and final approach for runway 26. The two air carrier aircraft nearest the airport were sequenced and landed without incident, and the final controller's attention was then primarily directed toward sequencing the third air carrier aircraft, a DC-9 operating as Eastern Air Lines Flight 630, (EA 630) and the two general aviation aircraft. Meanwhile, he had accepted handoff of two of the four aircraft inbound from the north feeder's airspace.

The final controller directed one general aviation aircraft, N5170U, which was at the lowest altitude and nearest to the airport, to turn to the west and onto final approach, in front of EA 630 as it descended from the north. As N5170U turned to the final approach course the controller recognized that EA 630 would overtake N5170U. To avoid the overtaking situation, he decided to take EA 630 out of the sequence by turning it north and reposition the flight on downwind for another approach. This situation diverted the final controller's attention at a time when two more aircraft were entering his airspace, Eastern Air Lines L-1011 Flight 453 (EA 453), eastbound, and Delta Airlines B727 Flight 565 (DL 565), southbound.

By 8:14 a.m., the final controller had accepted handoff of EA 453, which was descending through 8,500 feet, although radio communication between the controller and the aircraft had not been established. DL 565 had descended to 7,000 feet and had tuned to the final controller's frequency; however, since the final controller had not accepted the handoff, no positive control action was taken by either the feeder or the final controller to maintain separation between these two aircraft. The pilot of EA 453 saw DL 565 and increased his rate of descent to pass below it with about 400 feet vertical and 0.23 nmi lateral separation. The potential proximity of the two aircraft activated the conflict alert feature, the first of several activations of the conflict alert during the chain of events. The team supervisor instructed the feeder controller to hold further handoffs to the final controller and instructed Atlanta Center to hold off all traffic until the situation was resolved. The final controller recalled that the data tags associated with the two aircraft had overlapped and that he was not aware of DL 565's altitude.

Immediately following the encounter between EA 453 and DL 565, the final controller was confronted with the task of coordinating the two flights into the final approach sequence. He issued instructions to DL 565 to turn westbound toward the airport to "keep it from entering the south final controller's airspace," and he turned EA 453 south and then west to place it on final approach. Upon completion of its turn to the west, DL 565 was in an approach sequence behind general aviation aircraft N1583L, which was inbound on the final approach. However, DL 565 was too close to N1583L for both to continue the approach; consequently, the controller turned DL 565 to the north and then east while maintaining its 7,000-foot altitude in the feeder controller's airspace. This had the ultimate effect of placing DL 565 in another conflicting situation with an eastbound L-1011, Delta Airlines Flight 1049 (DL 1049). DL 1049 was descending to 7,000 feet while still under the control of and talking to the feeder controller. The conflict alert again activated, and the final controller instructed DL 565 to descend to 5,000 feet.

Meanwhile, the final controller had returned EA 630 into the sequence and had turned it to the south and then west for positioning on the final approach ahead of EA 453. However, upon completion of their respective turns, EA 453 was in nearly the same position and about 1,500 feet above EA 630. The controller turned EA 453 to the north; however, this action placed the aircraft in a conflicting situation with DL 565, EA 453, Eastern Airlines Flight 399 (EA 399), and an Air South deHavilland Twin Otter, Flight 301 (ASO 301). The conflict alert for EA 453 and DL 585 activated. All four aircraft were within a 2-square-mile area of each other when the conflict alert feature activated for all four aircraft. EA 399 was under the control of and talking to the feeder controller while the other three aircraft were under the control of and talking to the final controller. During the encounter, ASO 301 passed from right to left, about 0.8 nmi ahead of and 200 to 300 feet below EA 399. The pilot of EA 399 then sighted EA 453, which was approaching from right to left within 100 to 200 feet of the same altitude, and initiated a sudden climb to increase the separation. EA 399 and EA 453 passed within .06 nmi laterally and 600 feet vertically of each other. EA 399, in an attempt to climb quickly, exceeded the maximum exhaust gas temperature limits of its three engines. Shortly thereafter, two other aircraft also became involved in reduced separation situations which activated yet another conflict alert before the situation was resolved; however, neither represented a serious collision threat. After the aircraft passed on diverging courses, vectors were issued to restore order to the flow of approach traffic. Within 12 minutes, 15 aircraft had transited or approached the final controller's airspace.

Data Reduction from ATC Radar Computer Communication And Transcripts

The Atlanta terminal radar approach control (TRACON) is one of the few nonmilitary approach control facilities in the U.S. which records aircraft movement by

computer and stores it on magnetic tape. Following this incident, the Safety Board obtained these tapes and entered the data into its PDP-11 computer to reproduce the flight tracks of aircraft in the north feeder controller's and north final controller's airspace during the period of interest. By then taking this information and manually matching each radar hit with information contained on printouts from Atlanta Tower's ARTS III data extraction program, the Safety Board was able to create the 30-second Segmented Aircraft Movement Charts (SAM).

The Safety Board views the resulting presentations as a valuable method of investigating the circumstances of an ATC occurrence and as a useful substitute for a complete video replay of the events as they actually were presented on the controller's scope.

The training staff at Atlanta Tower has made a training film utilizing the SAM Charts and required all controllers at that facility to view the film. By listening to a recording of the controller-pilot conversations while proceeding from one SAM Chart to the next, one is able to follow clearly the sequence of the occurrences.

The following section shows precisely where the aircraft were, what was said between pilots and controllers, and the status of certain computer functions, such as handoff status, conflict alert, and track control, at 30-second intervals during this 6-minute period. Accompanying each chart on the left side of each page is a transcript of the recorded conversation which took place between the final controller and the aircraft on his frequency. The right side of the page contains comments or analyses regarding that 30-second period.

LEGEND

An aircraft's most recent position is depicted by the symbol: ►

Indicates aircraft is headed east: ►

Indicates aircraft is headed west: ◄

Indicates aircraft is headed north: ▲

Indicates aircraft is headed south: ▼

The distance covered in a 30-second segment is depicted by: ••••••►

An aircraft traveling very fast is depicted by: • • • • • ►

An aircraft traveling very slowly, is depicted by: ••••••►

An aircraft level at 6,000 feet is depicted by:

```
••••••►
  |
  60
```

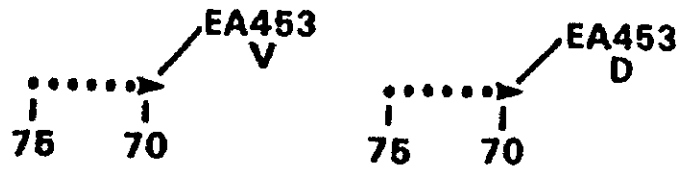
An aircraft descending from 7,300 feet to 6,900 feet in a 30-second segment is depicted by:

```
••••••►
|     |
73    69
```

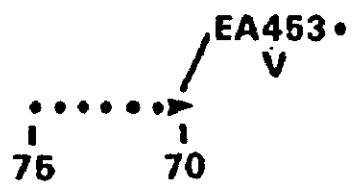
Aircraft are identified by flight number. For example Eastern Air Lines Flight 453 is depicted by:

```
      EA453
     /
••••••►
|     |
75    70
```

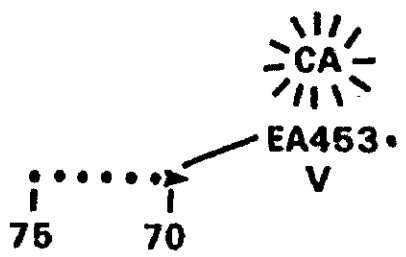
The controller responsible for the aircraft is indicated beneath the identification. The final controller is indicated by a "V," the feeder controller by "D." For example:



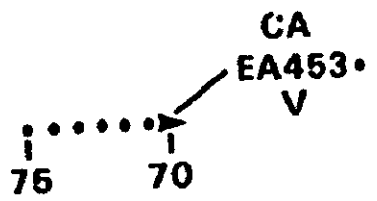
If the aircraft is on the final controller's frequency, a dot is placed behind the aircraft identification:



Activation of the conflict alert is depicted by:

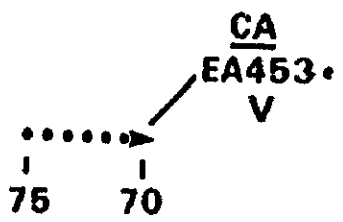


If the conflict alert activated during a prior 30-second segment and continued on into another 30-second segment, it is indicated by CA. For example:



If the conflict alert stops during a 30-second segment, it is depicted by <u>CA</u>.

For example:

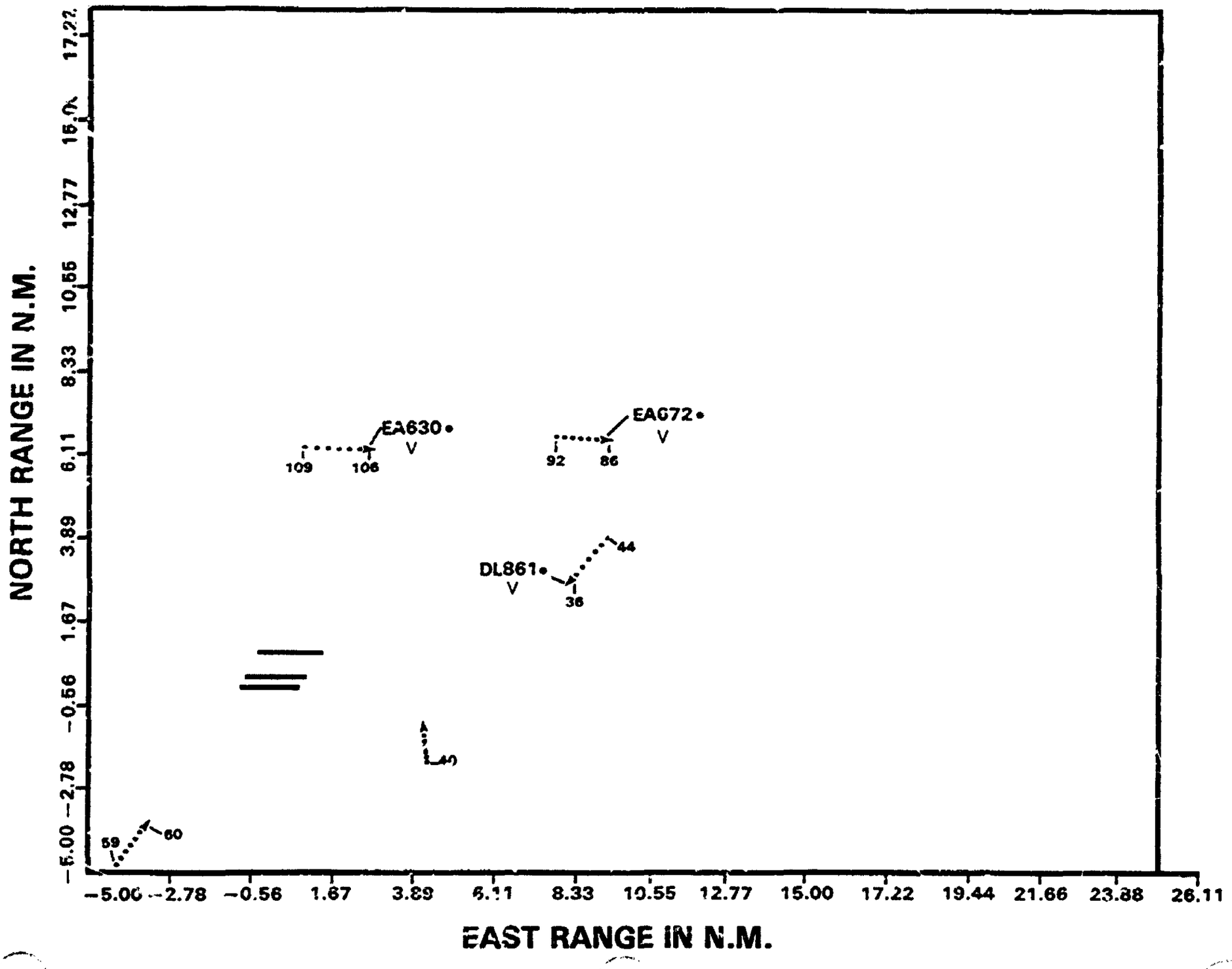


Target data were derived from the extraction of the beacon level target report data from the Atlanta ARTS-III tape for placement in an organized data base on the Safety Board's PDP-11 computer. The data are stored as a track-oriented file which allows retrieval of the data on a track by track basis. Track control and status of the conflict alert had to be manually added to the charts.

Designations for the source of voice transmissions are as follows:

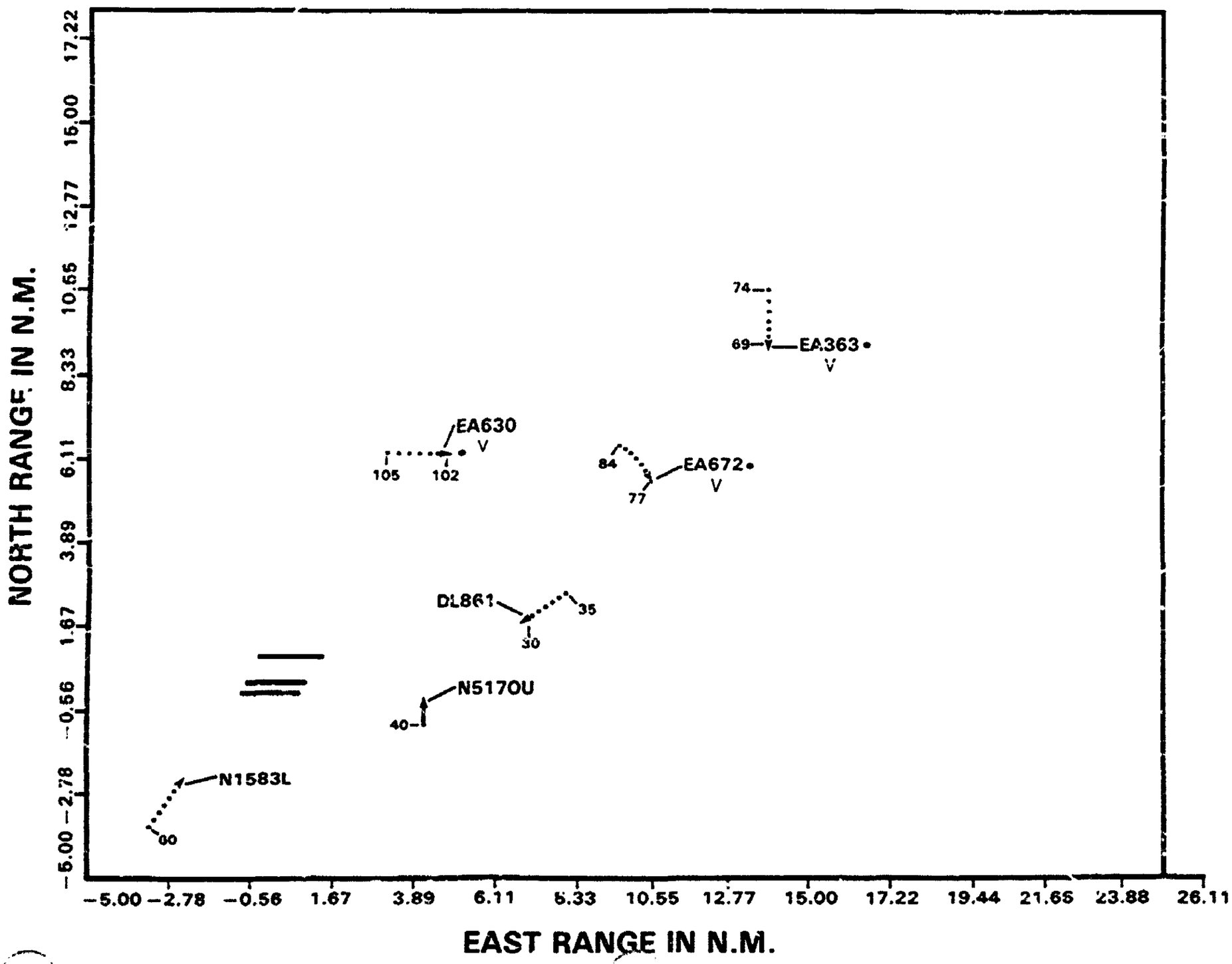
AR-V	Arrival Radar North Final Position
DR-N	Departure Radar North Position
TAR-D	Terminal Arrival Radar North Feeder Position
EA	Eastern
DL	Delta
PI	Piedmont
ASO	Air South

Identification of runways: The 3 horizontal lines at the bottom left of each page denote the airport runways.


08:08:00.0-08:08:30.0
NORTH RANGE IN N.M.
-5.00
-2.78
-0.56
1.67
3.89
6.11
8.33
10.55
12.77
15.00
17.22
EA630
V
109
106
EA672
V
92
86
DL861
V
44
36
59
60
-5.00
-2.78
-0.56
1.67
3.89
6.11
8.33
10.55
12.77
15.00
17.22
19.44
21.66
23.88
26.11
EAST RANGE IN N.M.

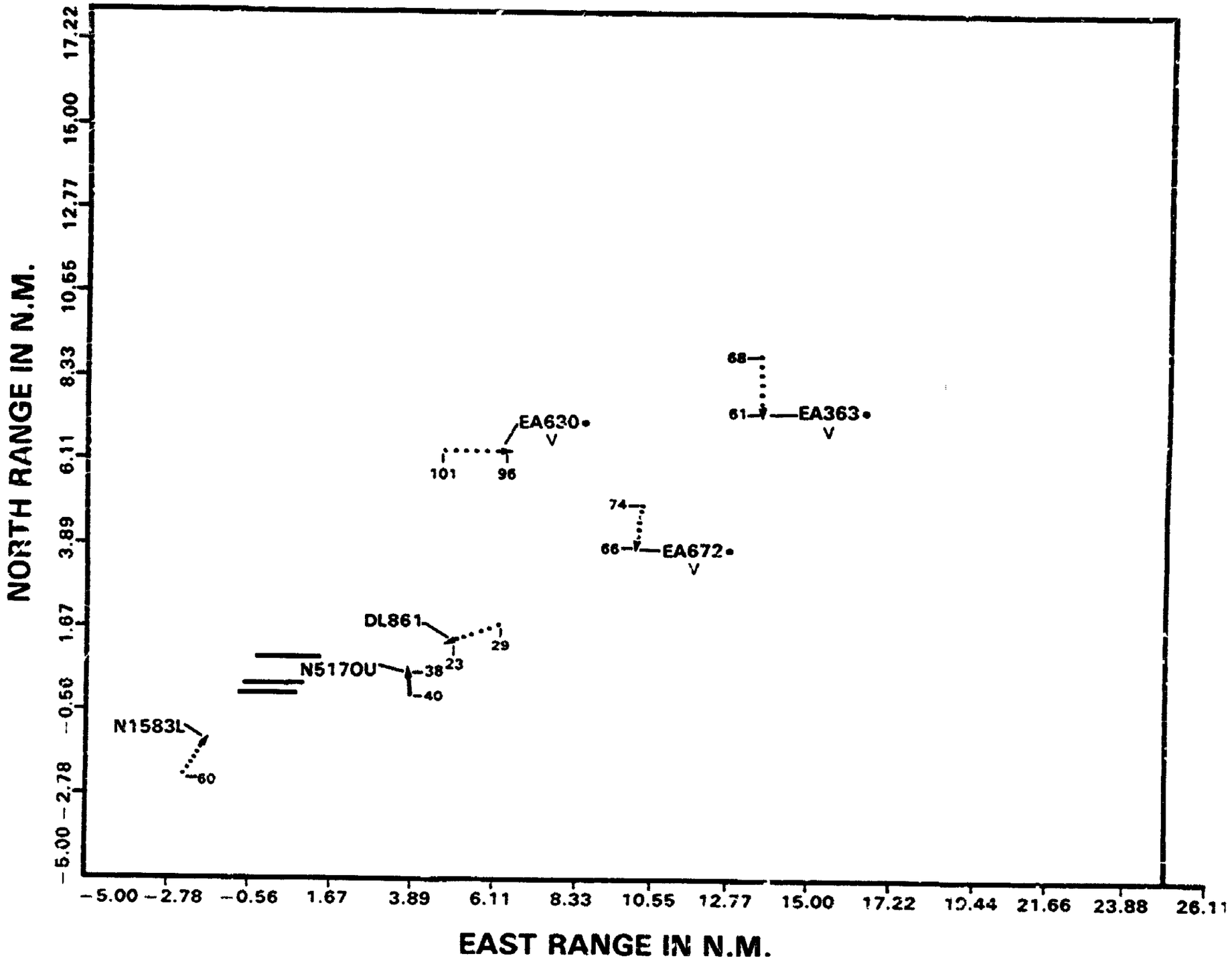
0808:02	EA630	Eastern six thirty's out of eleven for seven
0808:05	AR-V	Eastern six thirty roger
0808:06	AR-V	Eastern six seven two turn right heading one eight zero
0808:09	EA672	Right to one eighty-six seventy two
0808:11	AR-V	Roger and good rate of descent there
0808:16	AR-V	Eastern six thirty reduce speed to one seven zero
0808:20	EA630	Six thirty
0808:30	AR-V	Delta eight sixty one contact tower now one one niner point five

The two general aviation aircraft, N5170U (Cessna 172) and N1583L (Beechcraft King Air) are northbound, to be sequenced into the pattern for landing on the northern most of the parallel runways, runway 26. The TRACON supervisor made this decision because the General Aviation Terminal is located on the north side of the airport, north of runway 8-26.


08:08:30.0-08:09:00.0
NORTH RANGE IN N.M.
17.22
16.00
12.77
10.65
8.33
6.11
3.89
1.67
-0.56
-2.78
-5.00
74
69
EA363
V
EA630
V
105
102
84
77
EA672
V
DL861
35
30
N5170U
40
N1583L
60
-5.00 -2.78 -0.56 1.67 3.89 6.11 8.33 10.55 12.77 15.00 17.22 19.44 21.65 23.88 26.11
EAST RANGE IN N.M.

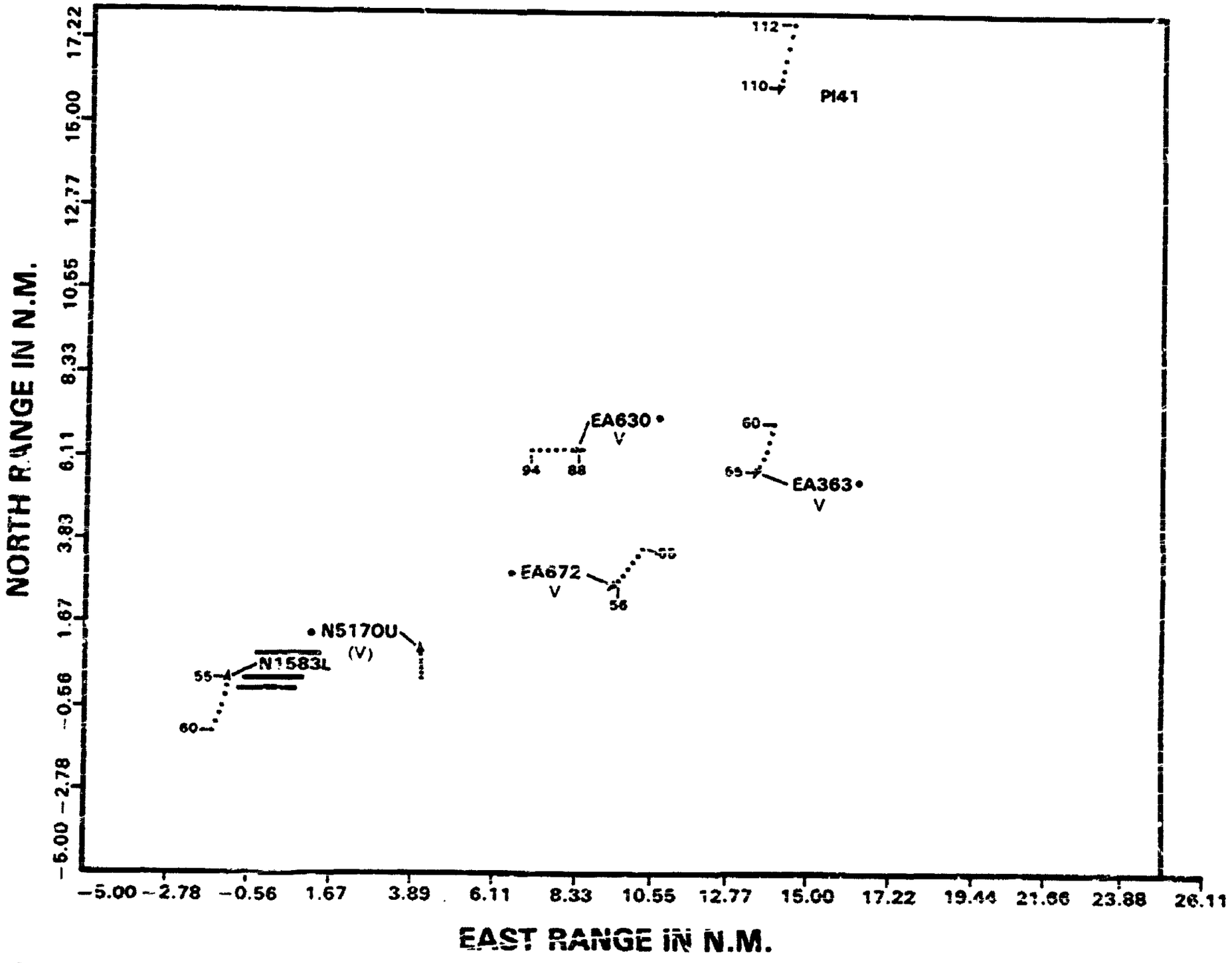
0808:34	DL861	Nineteen five good morning	The relative speeds of the aircraft should be noted. Note the distance between each "hit" of the radar for N517OU, N1583L, and EA672. The total distance traveled for these three aircraft in the 30-sec time period should be noted. N517OU's speed appears to be about 1/2 that of EA672 and N1583L.
0808:56	AR-V	Eastern three sixty three descend and maintain five thousand	

08:09:00.0-08:09:30.0

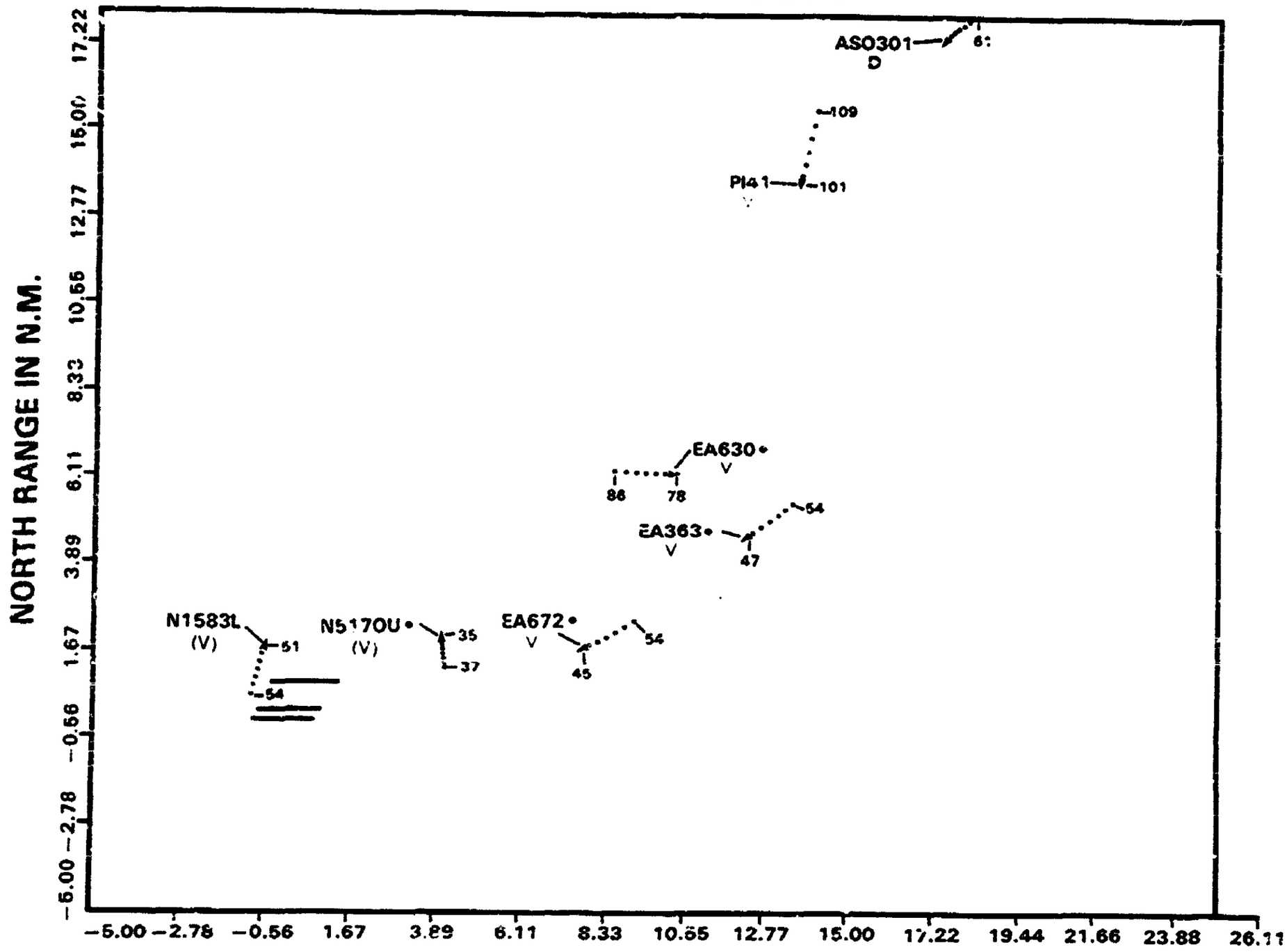


0809:00	EA363	Down to five thousand Eastern three six three	EA363 is being brought into the pattern on the base leg, to be followed by EA630.
0809:02	AR-V	Eastern six seventy two turn right heading two four zero advise airport in sight	
0809:07	EA672	Two forty and we're looking at it six seventy two	
0809:09	AR-V	Eastern six seventy two clear for visual approach runway two six	
0809:14	EA672	Seventy two	
0809:23	AR-V	Eastern three sixty three turn right heading two four zero	
0809:28	EA363	Three six three	

08:09:30.0-08:10:00.0



0809:43	AR-V	Seven zero Uniform descend and maintain three thousand one hundred	3,100 ft is assigned to N5170U because that is the minimum vectoring altitude in that particular area.
0809:48	N5170U	Descend to three thousand one hundred seven zero Uniform	
0809:52	AR-V	Eastern three sixty three descend and maintain four thousand advise when airport in sight	
0809:58	EA363	Eastern three six three four thousand we have the airport	
0809:59	AR-V	Eastern three sixty three cleared for visual approach runway two six uh you're five miles behind traffic I'll keep you advised on spacing	Note that the final controller cleared EA363 for a visual approach, and then pointed out the traffic. Visual approach should be used only after "the succeeding aircraft reports sighting the preceding aircraft." (ATC 7110.65A, paragraph 790.)


08:10:00.0-08:10:30.0
NORTH RANGE IN N.M.
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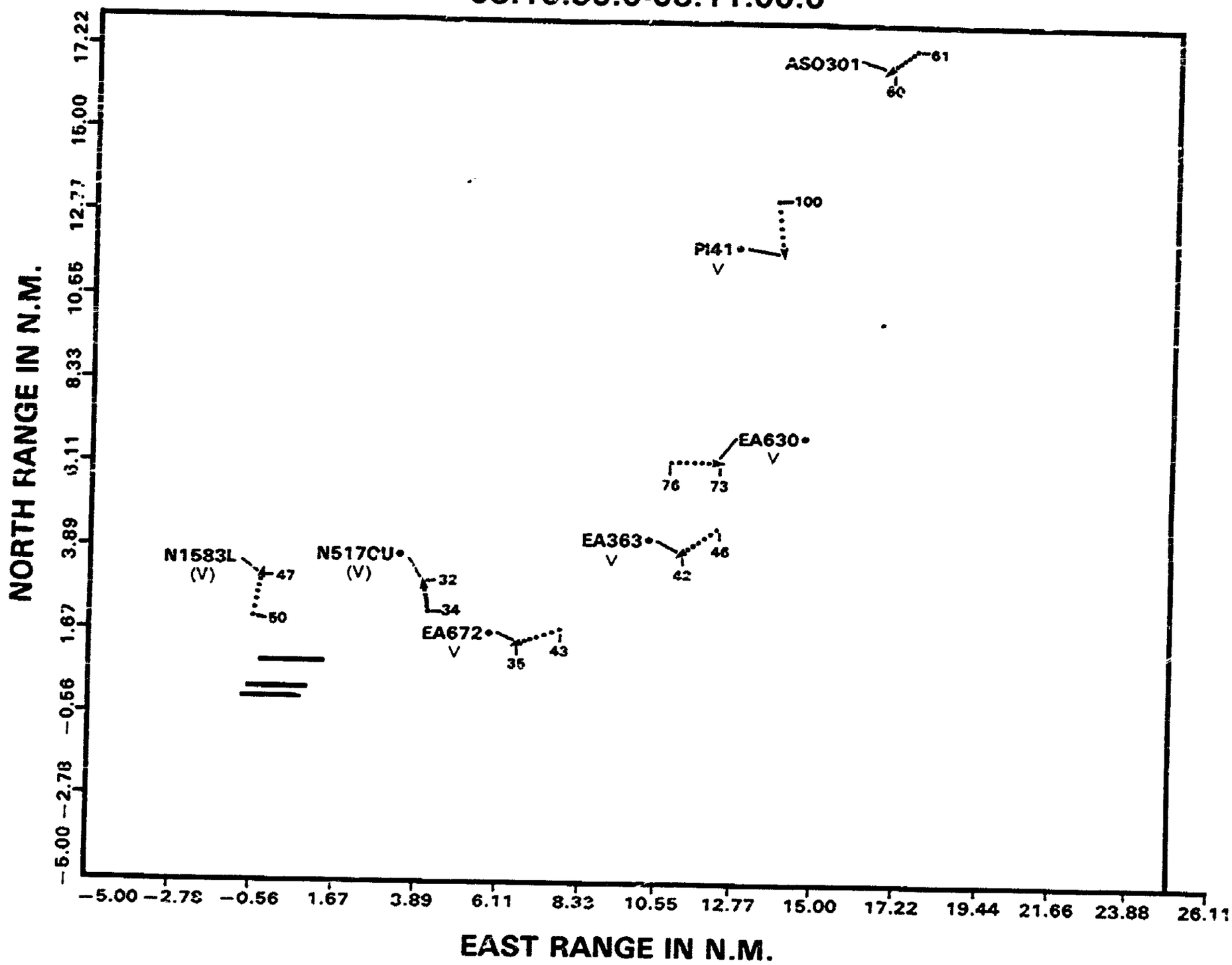
-5.00 -2.78 -0.56 1.67 3.89 6.11 8.33 10.55 12.77 15.00 17.22 19.44 21.66 23.88 26.11
EAST RANGE IN N.M.
ASO301
109
PI41
101
EA630
86
78
EA363
54
47
N1583L
(V)
51
54
N5170U
(V)
35
37
EA672
54
45

0810:06	EA3S3	Okay is that him a little higher than us
0810:03	AR-V	That's correct that's five thousand three hundred descending
0810:11	EA363	Okay three six three
0810:14	P141	Piedmont forty one out of ten thousand for six
0810:17	AR-V	Piedmont forty one turn left heading one six zero reduce speed to one seven zero runway two six other traffic landing on two seven left
0810:24	P141	One uh six zero heading one zero zero on the speed Piedmont forty one
0810:29	AR-V	That's correct

Eastern 363 confirmed that he saw his traffic. The symbols "V" located under the aircraft identification indicate that the "final" controller has accepted control of the aircraft. Aircraft still under control of the "feeder" controller is designated with a "D."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NORTH RANGE IN N.M.
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ASO301
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PI41
EA630
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EA363
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N1583L
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N517CU
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EA672
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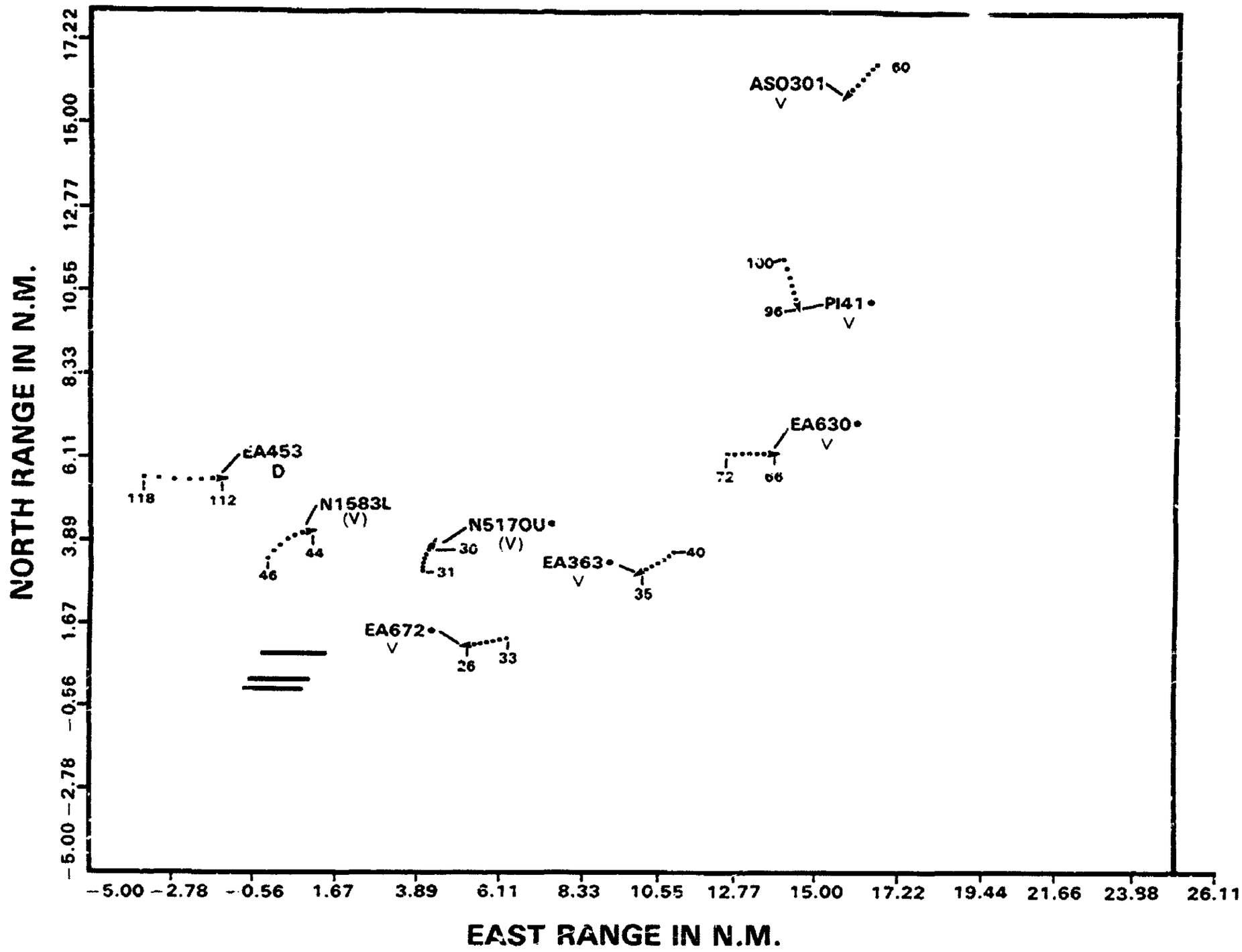
-5.00 -2.78 -0.56 1.67 3.89 6.11 8.33 10.55 12.77 15.00 17.22 19.44 21.66 23.88 26.11
EAST RANGE IN N.M.

0810:30	AR-V	Eastern six thirty descend and maintain five thousand	
0810:33	EA630	Five Eastern six thirty	
0810:35	DR-N	A this is N	
0810:36	AR-V	Yes	
0810:36	DR-N	Verify seven zero Uniform's altitude	The conversation here between the "V" and "N" controllers shows that the "N" controller was assuring separation between N1583L and N5170U before instructing N5170U to change frequency.
0810:41	AR-V	That's three thousand one hundred	
0810:41	DR-N	Alright that King Air eight three Lima'll be going to four thousand	
0810:44	AR-V	Okay	
0810:49	AR-V	Eastern six seventy two contact tower now one niner point uh five	The final controller accepts the handoff of ASO301 from the feeder controller.
0810:54	EA672	Nineteen five good day	


AS0301
V
60
100
96
PI41
V
EA630
V
72
66
EA453
D
118
112
N1583L
(V)
46
44
N5170U
(V)
30
31
EA363
V
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EA672
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NORTH RANGE IN N.M.
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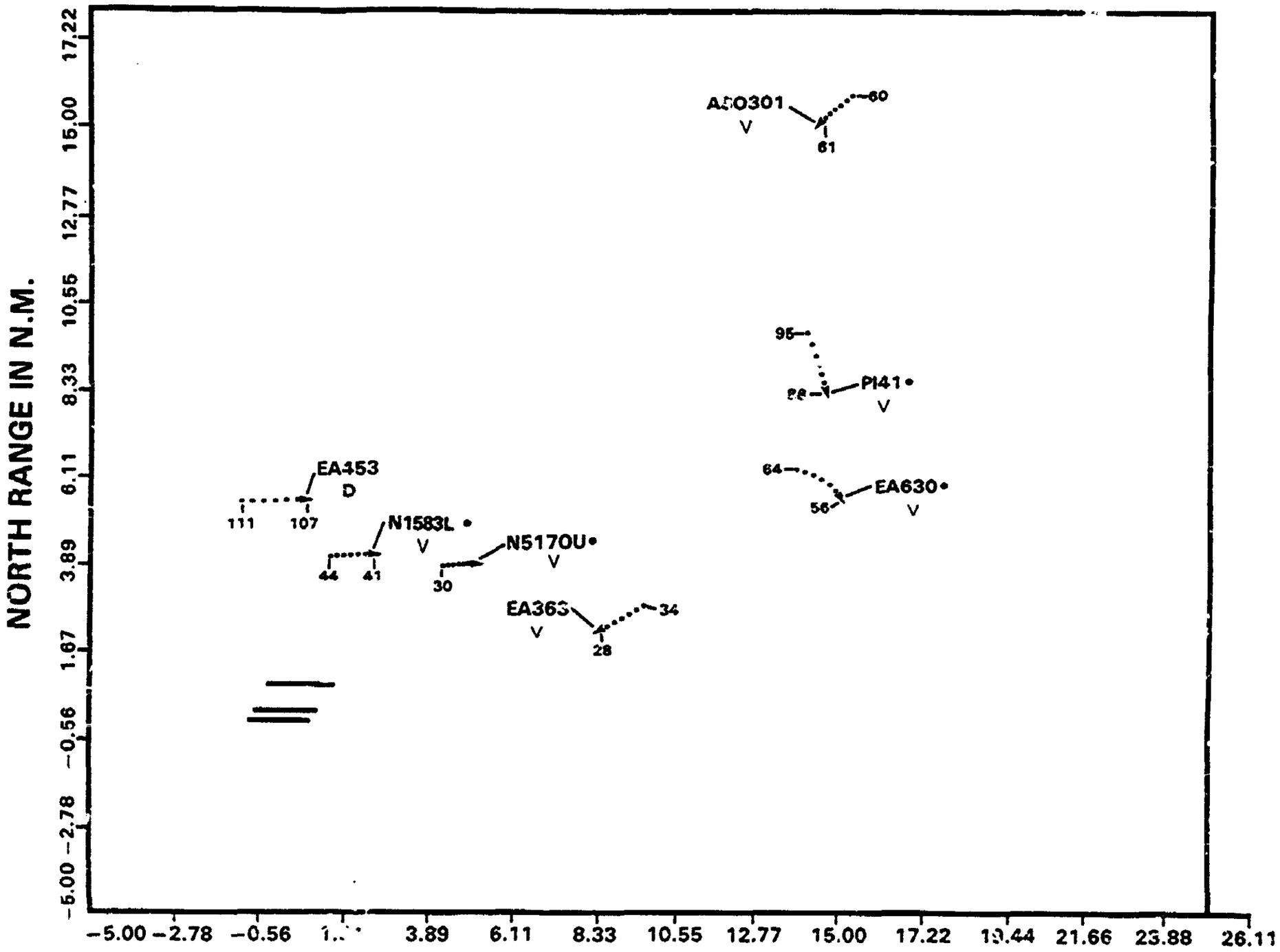
23.88
26.11
EAST RANGE IN N.M.

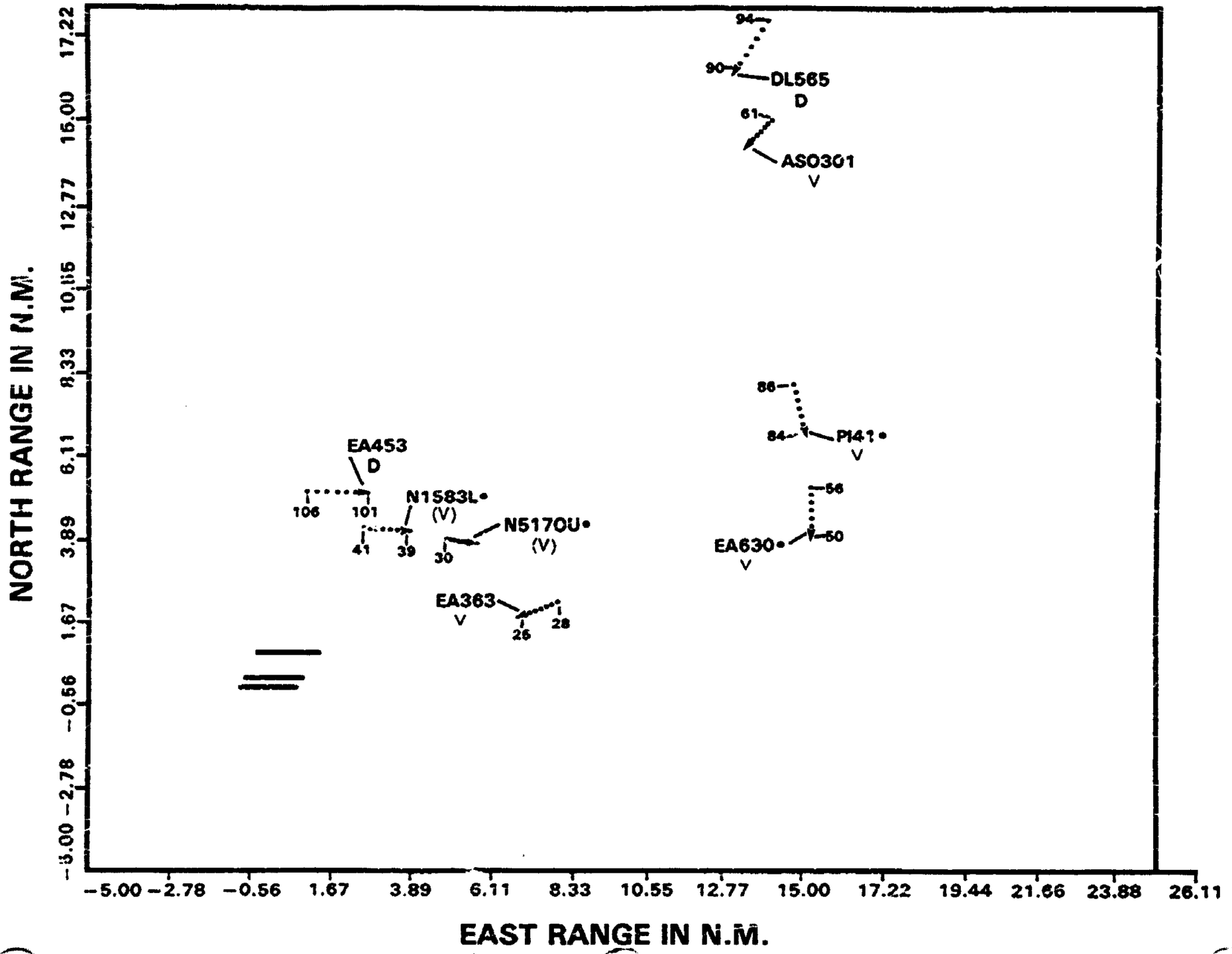
0811:03	AR-V	Seven zero Uniform turn right heading zero niner zero	EA453, under the control of and talking to the feeder controller, asks, "How long a final do you plan for Eastern four fifty three?" The feeder controller replied, "Our final is about fifteen miles Eastern four fifty three." EA453 was then assigned six thousand and told to change to the final controller's frequency. EA453 was descending out of 11,700 ft when this inquiry was made. Later on it will become apparent that the reason for the question was that the flight might have wanted to remain "high" for as long as possible. (There is a 250 knot speed limit below 10,000 ft.)
0811:07	N5170U	Zero nine zero Uniform	
0811:18	AR-V	Eastern six thirty turn right heading one eight zero	
0811:21	EA630	Six thirty one eighty	

08:11:30.0-08:12:00.0



0811:38	AR-V	Eastern three sixty three tower now one one niner point five	The flightpath of N5170U should be noted. The final controller has assigned a heading of 090 to the aircraft, taking it away from the airport. In view of the relative speeds of the aircraft involved, this created an unwarranted increase in workload.
0811:42	EA363	Three six three	A better technique would be to keep slower traffic in <u>closer</u> to the airport, create a "slot," and then put that slow aircraft in that slot. The closer slow traffic can be kept to the airport, the less opportunity there is for faster traffic to create a "problem." Speed control could also be applied to the faster traffic.
0811:48	N1583L	Atlanta approach King Air one five eight three Lima descending to four thousand	
0811:52	AR-V	Eight three Lima roger runway two six other traffic landing on two seven left	
0811:59	AR-V	Eastern six thirty turn right heading two four zero	

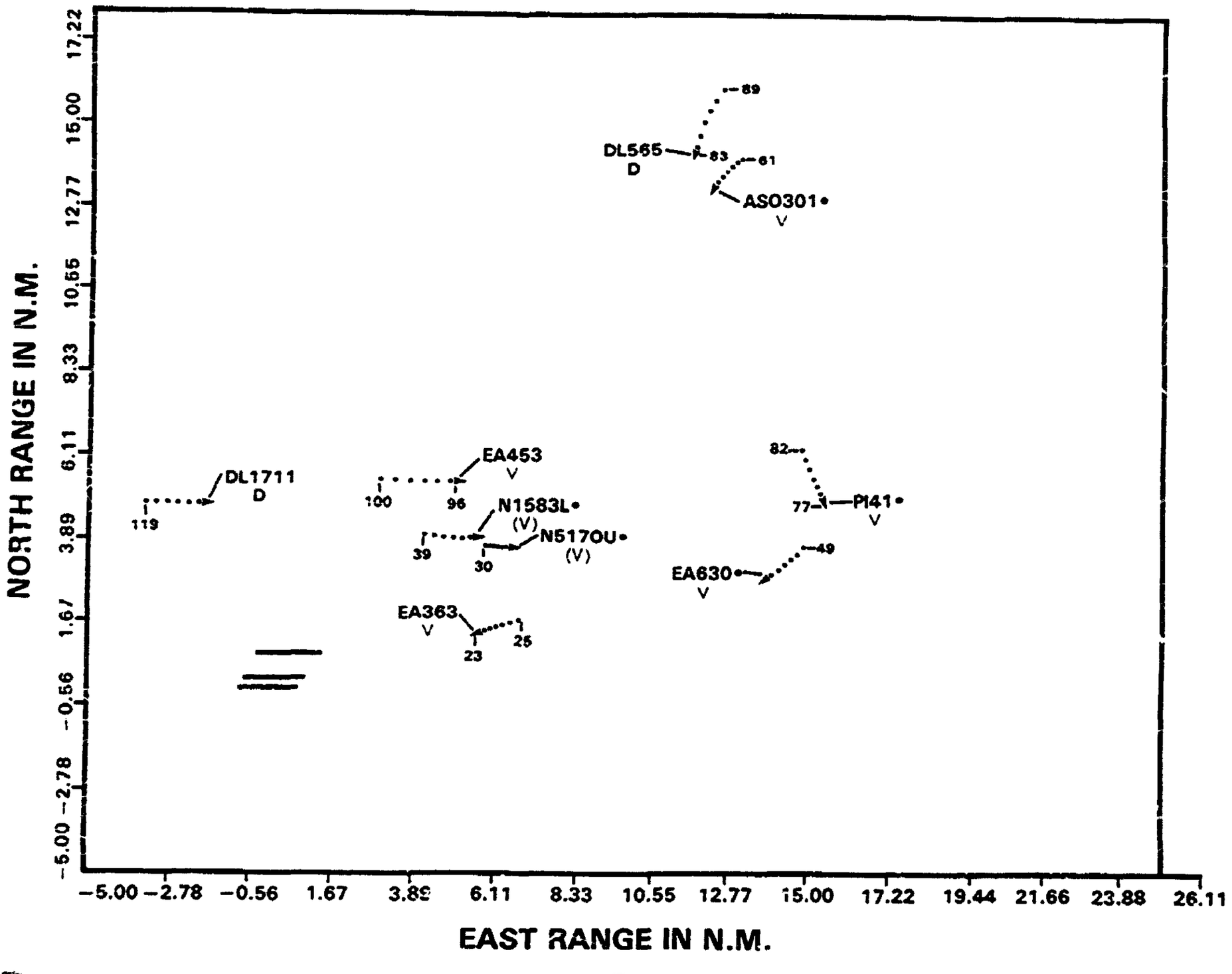
08:12:00.0-08:12:30.0



0812:02	EA630	Two four zero Eastern six thirty
0812:04	AR-V	Seven zero Uniform traffic for you a Eastern uh DC nine now that is uh almost nine o'clock to you three miles westbound two thousand seven hundred you have 'em in sight
0812:19	N5170U	You say nine o'clock or three o'clock
0812:21	AR-V	I'm sorry three o'clock
0812:23	N5170U	Uh roger contact (unintelligible)
0812:24	AR-V	Say you have 'em in sight
0812:26	N5170U	Affirmative
0812:27	AR-V	Say again seven zero Uniform
0812:29	N5170U	That's affirmative
0812:30	AR-V	Seven zero Uniform right turn in behind that aircraft it's so close as possible caution wake turbulence clear for visual approach runway six follow that traffic

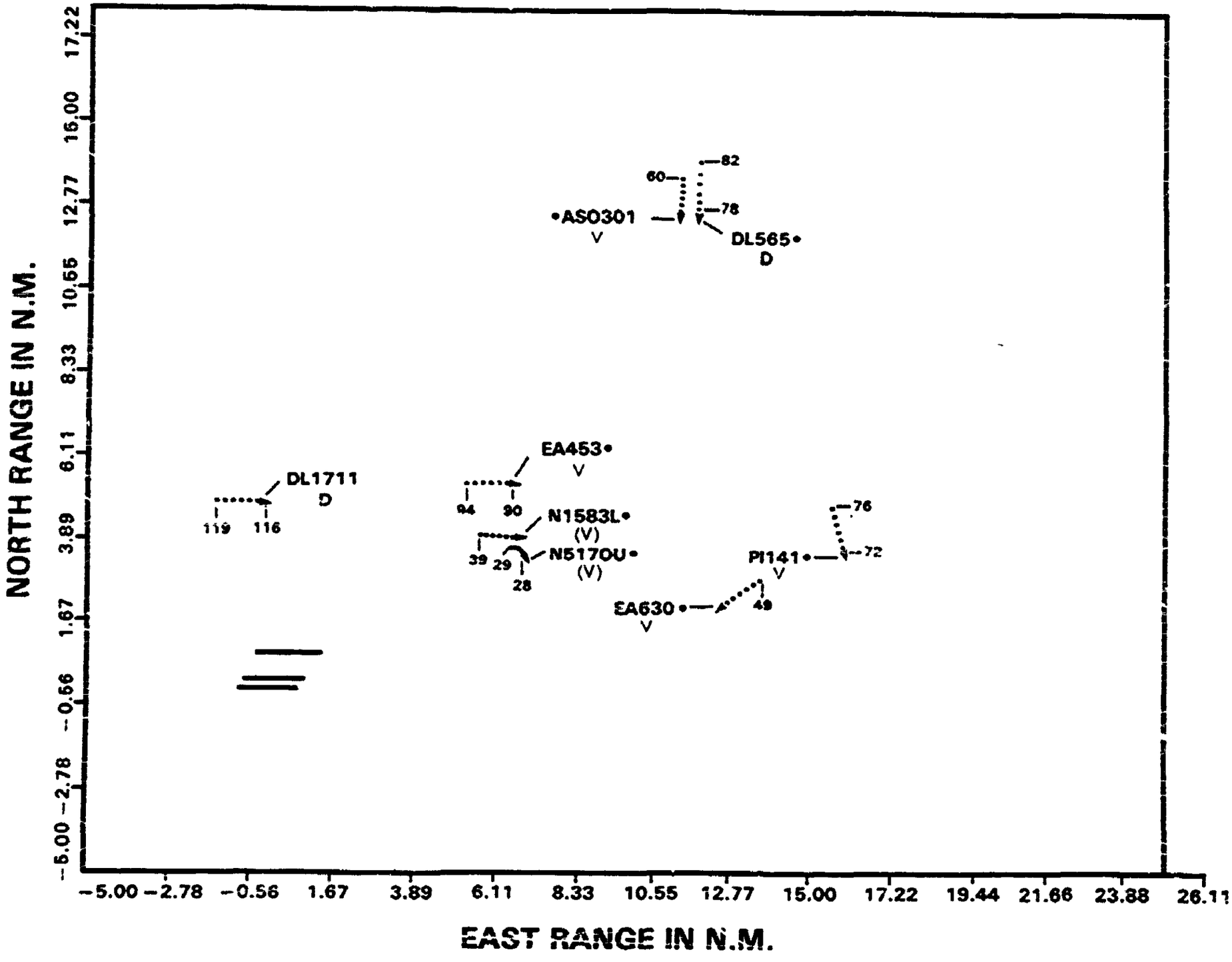
The feeder controller has assigned a heading of 180 to DL565. Although flights are normally transferred from the feeder controller to the final controller descending to 6,000, DL565 was "stopped" at 7,000 because of ASO301 immediately ahead at 6,000.

08:12:30.0-08:13:00.0

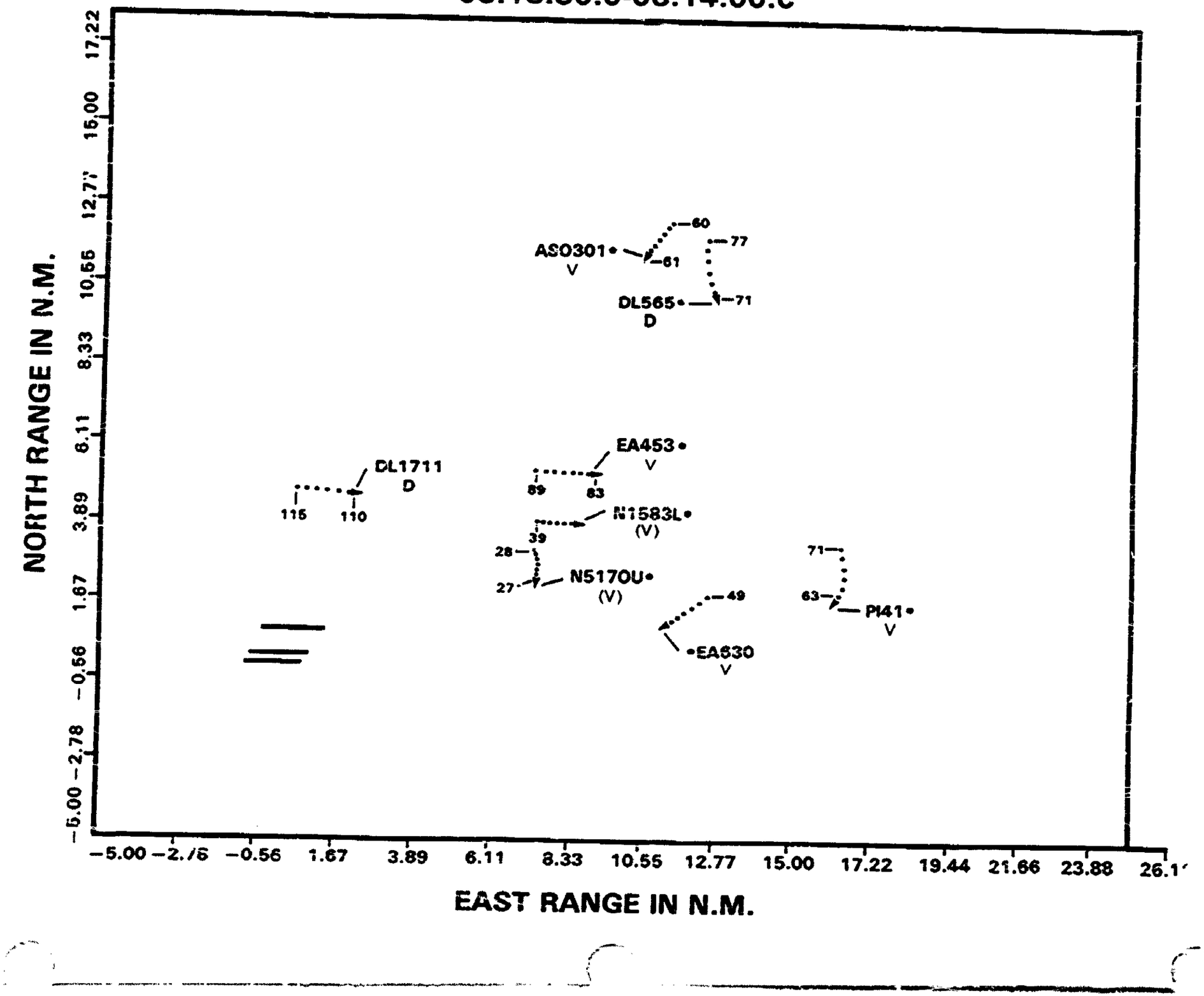


0812:38	N5170U	Er roger seven zero Uniform	The final controller accepts the handoff of EA453 from the feeder controller. (The control symbol has changed from a "D" to a "V".)
0812:41	AS0301	Atlanta ASO three oh one is with you four thousand six thousand	
0812:45	AR-V	ASO three oh one roger runway two six other traffic landing on two seven left	
0812:49	ASO301	Three oh one	
0812:50	AR-V	Eastern six thirty proceed inbound on localizer advise when airport in sight	Traffic again was not pointed out to an aircraft before receiving clearance for a visual approach.
0812:55	EA630	Eastern six thirty we have the airport	Note that N5170U had been instructed to turn in behind EA363 but 30 sec after the instruction was issued, the aircraft is still heading eastbound. This compounded the problem of sequencing N5170U with the traffic flow.
0812:57	AR-V	Eastern six thirty cleared visual approach runway two six	

08:13:00.0-08:13:30.0



0813:02	EA630	Eastern's er six thirty roger and what's our traffic	Because of the visual approach clearance issued to EA630, EA630 then asks the controller "what's our traffic."
0813:05	AR-V	Your traffic'll be a Cessna turning in front of you I'll keep you advised of the spacing behind 'em	At this point in time it should have been apparent to the final controller that N5170U cannot be in front of EA630. The plan should be for N5170U to be behind EA630, in front of PI41, and for PI41 to reduce speed.
0813:10	EA630	Okay	Mentally "projecting" the distance that N5170U travels against the distance EA630 travels in the same period of time will show about where their paths will cross. At the end of this 30-sec period that crossing point would appear to be about 6 miles from the end of the runway on final approach.
0813:11	AR-V	Piedmont forty one descend and maintain five thousand	
0813:14	PI41	Five thousand Piedmont forty one	
0813:16	AR-V	Okay seven zero Uniform turn your base leg now tighten it up please	
0813:21	N5170U	Seven zero	
0813:22	AR-V	Roger and keep your speed as long as practical	
0813:25	DL565	Delta five sixty five with you	
0813:27	AR-V	Piedmont forty one turn right heading two five zero proceed inbound on localizer advise when airport in sight	


NORTH RANGE IN N.M.
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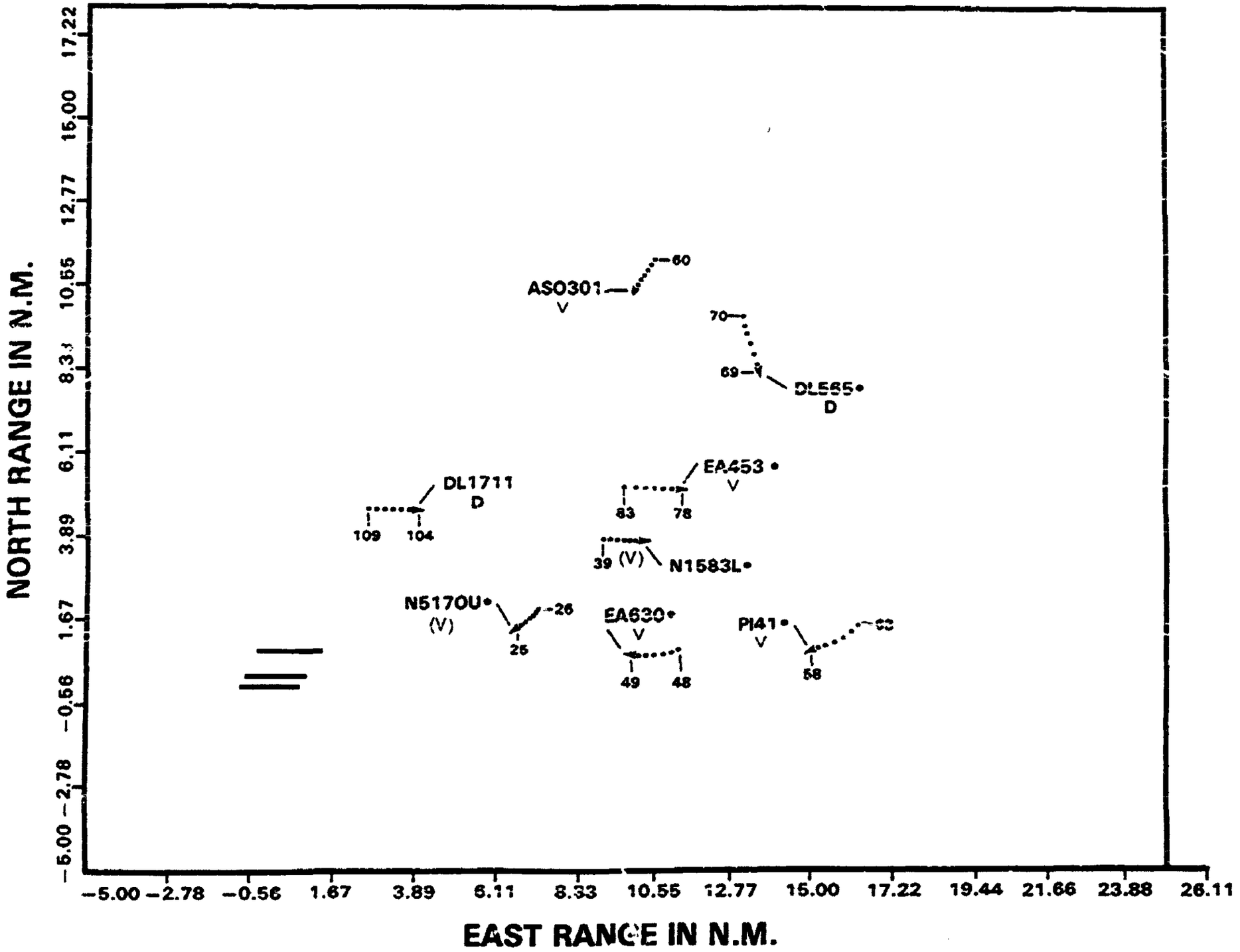
-5.00
-5.00 -2.78 -0.56 1.67 3.89 6.11 8.33 10.55 12.77 15.00 17.22 19.44 21.66 23.88 26.1
EAST RANGE IN N.M.
AS0301
V
60
61
77
DL565
D
71
DL1711
D
115
110
EA453
V
89
83
N1583L
(V)
39
28
N5170U
(V)
27
49
EA630
V
71
63
PI41
V

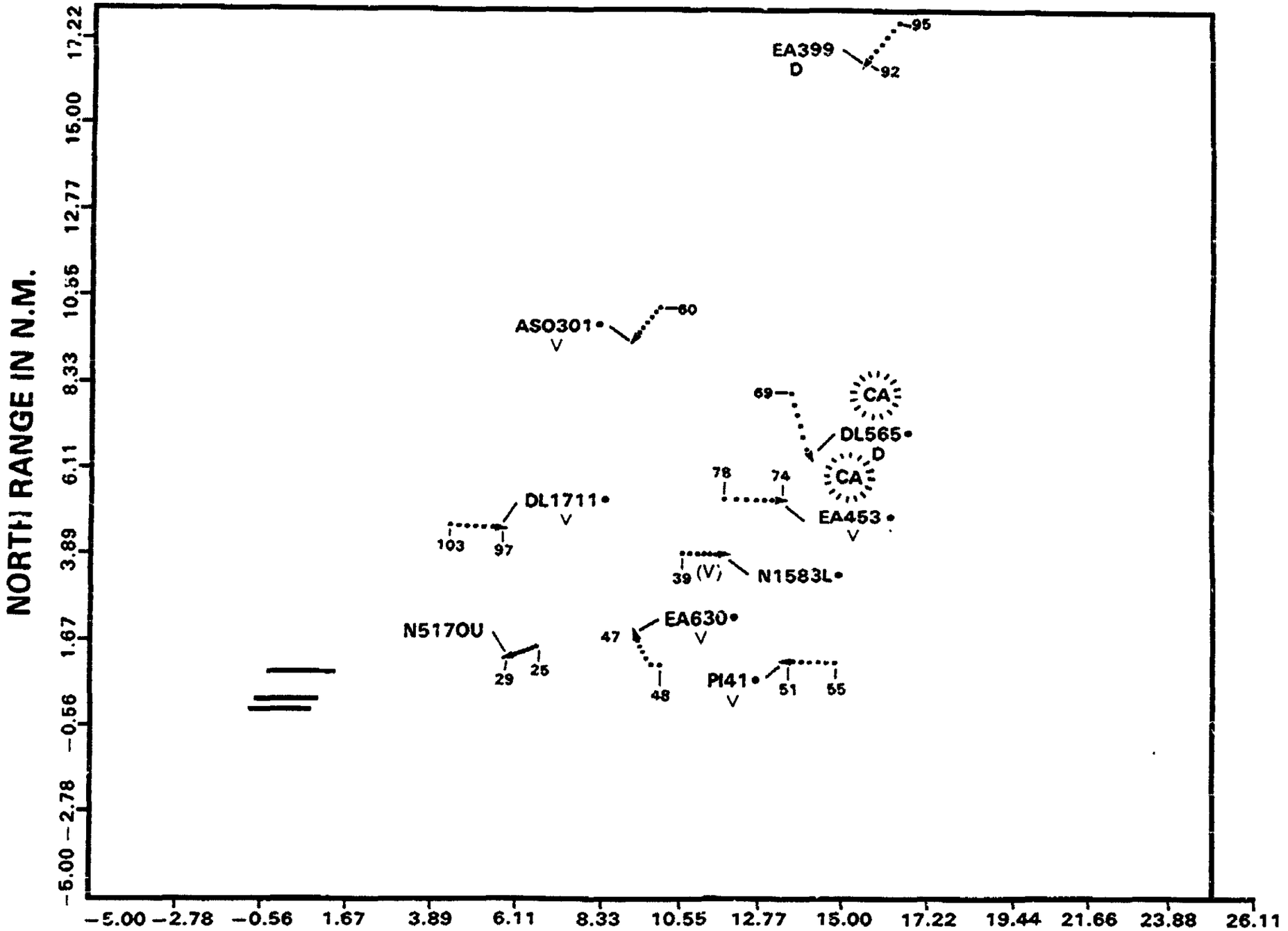
0813:33	PI41	Two five zero inbound on localizer and we have the airport in sight Piedmont forty one	The visual approach clearance without pointing out preceding traffic should be noted.
0813:38	AR-V	Piedmont forty one cleared for visual approach runway two six	EA630 is "catching" N5170U. This should definitely have been recognized at this point, and appropriate action taken.
0813:42	PI41	We're clear for visual approach runway twenty six Piedmont four one	
0813:48	AR-V	Seven zero Uniform turn right heading two six zero and continue inbound straight in to the airport please for two six	
0813:54	N5170U	Seven zero Uniform	
0813:56	AR-V	Seven zero Uniform contact tower now one one niner point five	

08:14:00.0-08:14:30.0



08__.02	N5170U	One one niner point five	EA630's 0814:17 remark that they could have slowed is significant. During the time period covered in this investigation, the final controller never used the speed adjustment as part of his technique.
0814:04	AR-V	One one niner point five	During this 30-sec period, the final controller is getting behind. He accepted the handoff on EA453, but EA453 did not establish communication. The data tag for DL565 is flashing, indicating that he needs to accept the handoff. DL565 at 7,000 and EA453, descending to 7,000, are converging. The final controller did not see this nor did the feeder controller. Additionally, the feeder controller could be considered to be "forcing" DL565 to the final controller because the feeder controller "put" DL565 on the final controller's frequency without the final controller accepting the handoff.
0814:06	N5170U	Roger	
0814:09	AR-V	Eastern six thirty I'm gonna have to break you out turn right heading of three two zero Eastern six thirty	
0814:17	EA630	Roger Eastern six thirty that's three twenty if we'd had a little advance warning on that Cessna we could have slowed up way out there	
0814:22	AR-V	Okay Eastern six thirty turn right heading of three five zero now and uh just maintain four thousand five hundred	
0814:29	EA630	Forty five hundred and three fifty heading Eastern's er six thirty	

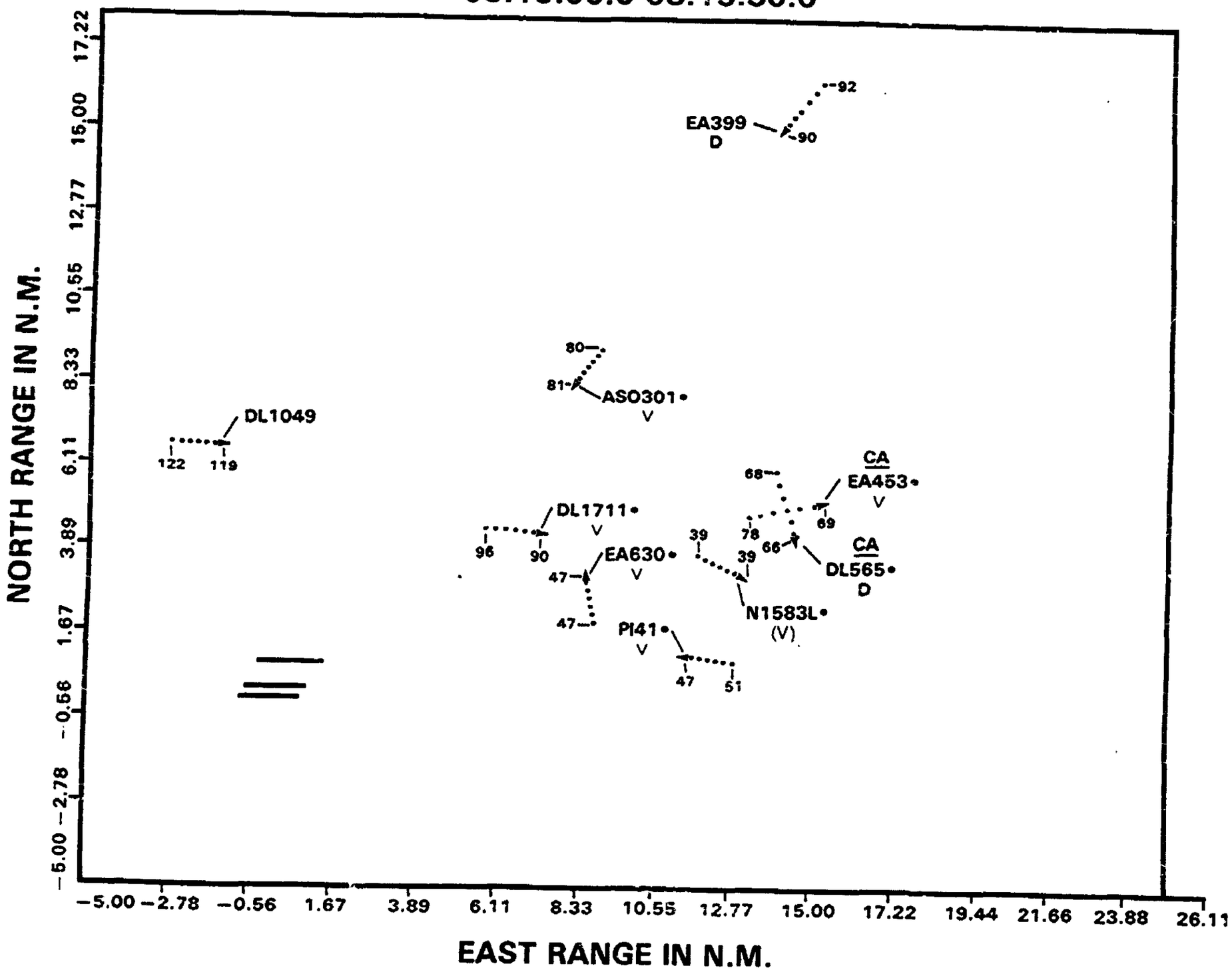
08:14:30.0-08:15:00.0



0814:33	AR-V	Ah roger

At 1437, the conflict alert activated for both DL565 and EA453. When the final controller asked DL565, "you with me," the controller would normally look at the target and associated data tag of the aircraft being addressed. When the final controller did this he should first have seen the presence of another aircraft and then looked to see the altitude of that other aircraft. Because the feeder controller still had electronic track control of the DL565 data tag, the conflict alert activated on both the controllers' scopes. However, for reasons to be discussed later in this report, both controllers missed the conflict alert. This does not explain why the final controller did not see EA453's altitude, and take the appropriate corrective action. It should be noted though, that the final controller stated that the data tags overlapped for EA453 and DL565. He also stated that he didn't know that DL565 was at 7,000 feet.

0814:34	AR-V	Delta five sixty five you with me
0814:37	DL1711	Delta seventeen eleven descending to seven
0814:40	AR-V	Delta seventeen eleven roger runway two six
0814:43	DL1711	'Kay
0814:45	DL565	Delta five sixty five here
0814:47	AR-V	Five sixty five roger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NORTH RANGE IN N.M.
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EA399
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EA453
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DL1711
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N1583L
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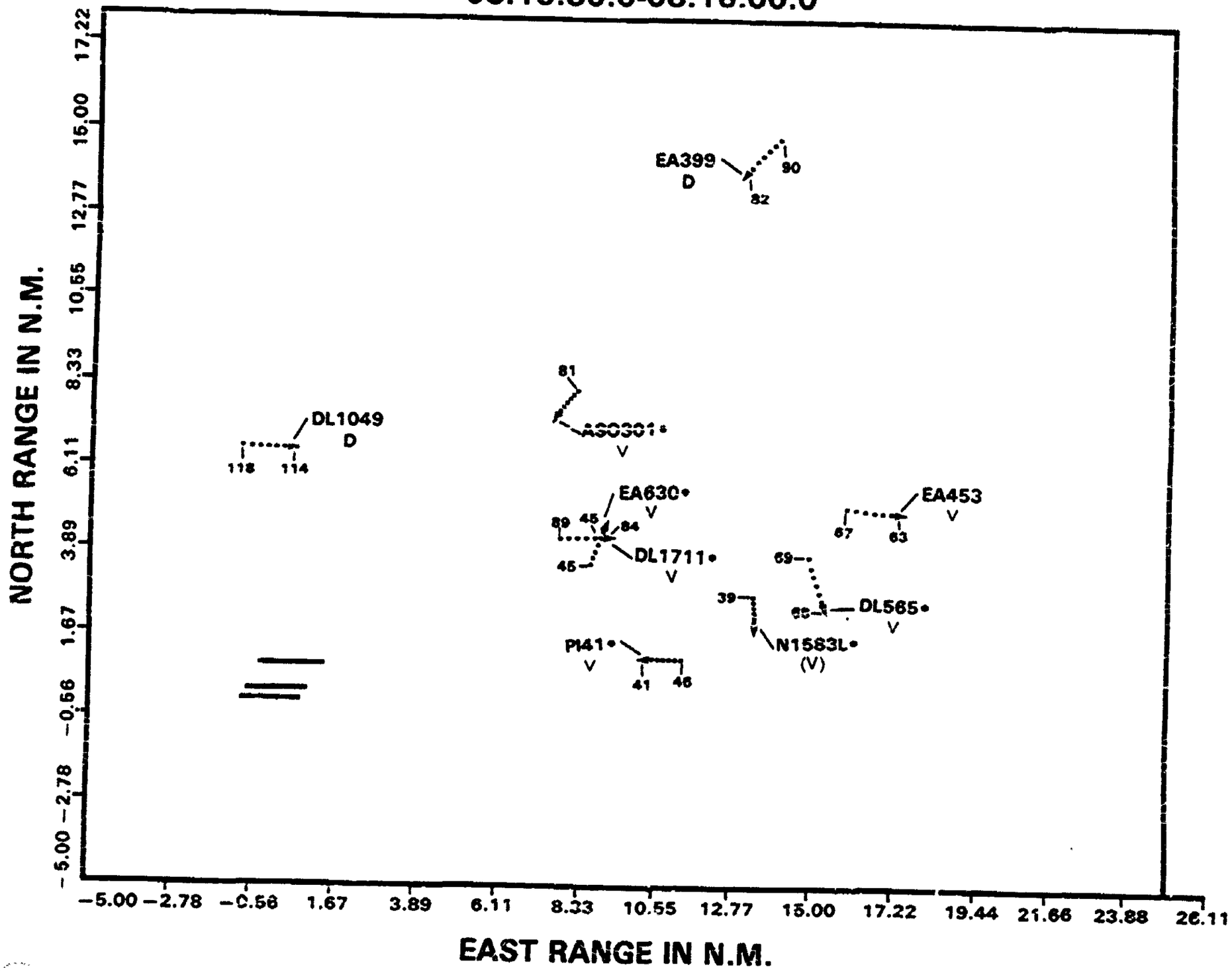
EAST RANGE IN N.M.

0815:03	AR-V	Eight three Lima turn right heading one eight zero	During the investigation of this incident, the final controller said that he pictured or visualized EA453 going below DL565. This would have happened if EA453 had descended earlier to it's assigned altitude of 6,000 ft. About 4 minutes prior to this, EA453 inquired about "how long the final was."
0815:05	N1583L	One eighty eight three Lima	EA453 and DL565 missed each other by 400 ft and 0.23 nmi.
0815:17	DL565	Approach five sixty five	
0815:20	AR-V	Eastern six thirty turn right heading zero niner zero	
0815:23	EA630	Zero nine zero Eastern six thirty	
0815:29	DL565	Approach Delta five sixty five	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NORTH RANGE IN N.M.
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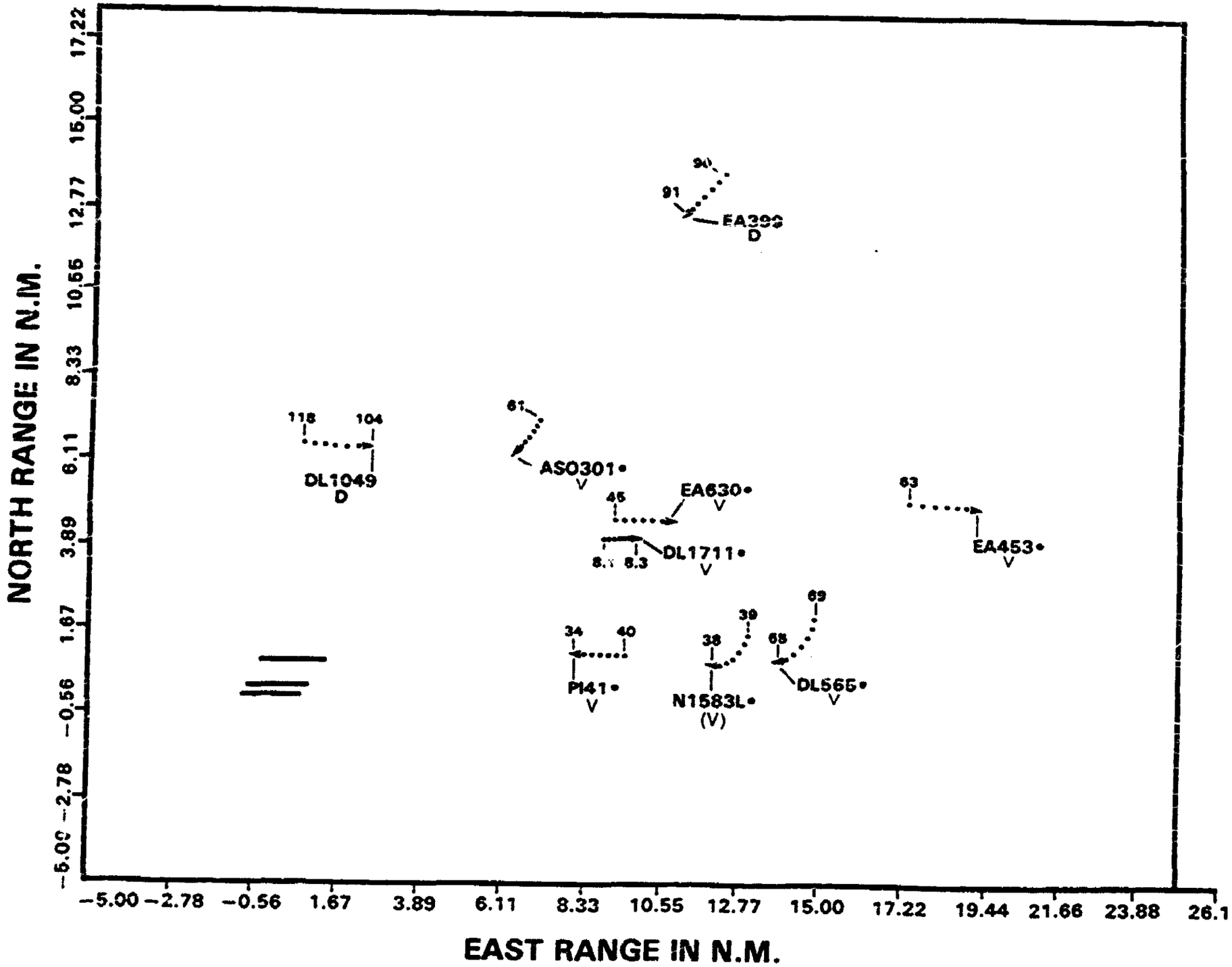
EAST RANGE IN N.M.

0815:31	AR-V	Delta five sixty five say heading	During this time period, the final controller accepted the handoff on DL565.
0815:33	DL565	One sixty	The final controller stated that the reason the turn to 270° was issued to DL565 before a turn was issued to N1583L was because he was concerned that DL565 would get into the "South Final's Airspace."
0815:41	DL565	Seven thousand and we wanta know what altitude Eastern just went by us at	
0815:44	AR-V	Okay Delta five sixty five reduce speed to one seven zero turn right heading two seven zero	
0815:51	DL565	Two seventy and a hundred and seventy	
0815:54	AR-V	Okay eight three Lima advise the airport in sight	
0815:59	N1583L	Oh we're looking at it	


NORTH RANGE IN N.M.
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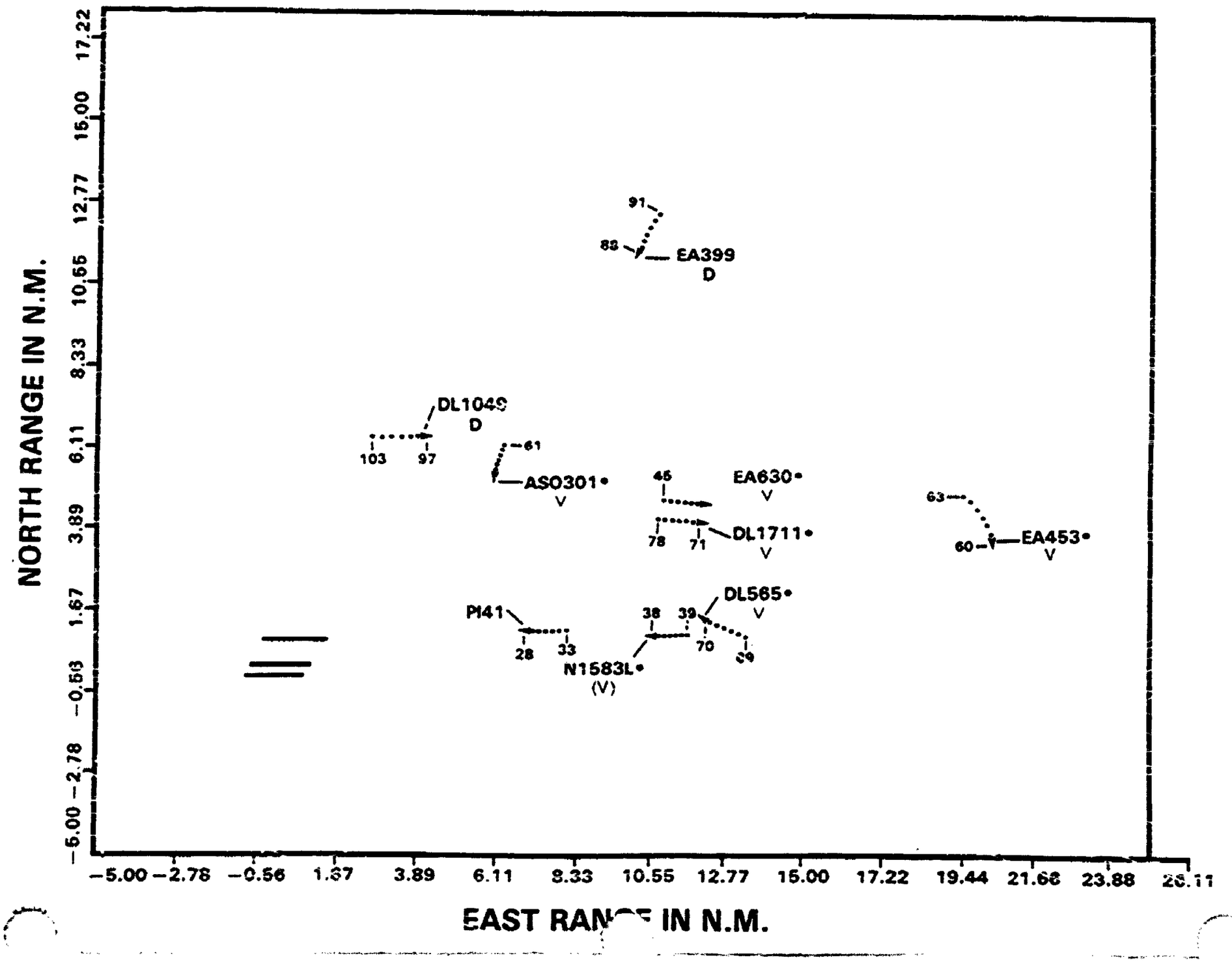
EAST RANGE IN N.M.

0[illegible]J0	AR-V	Eight three Lima turn and make a sha[illegible]urn and turn inbound cleared for visual approach runway two six	PI41 was not pointed out as preceding traffic before approach clearance was issued. The final controller is now extremely busy, and getting further behind. During the investigation the final controller said that at this point he was "too involved" to ask for help. Although he couldn't recall exactly when, he remembered hearing the supervisor "telling them not to put them on me." (Don't give any more aircraft to the final controller.)
0816:05	N1583L	Three Lima	
0816:06	AR-V	Delta five sixty five turn right heading three zero zero	
0816:10	DL565	Three hundred degrees five sixty five	
0816:12	AR-V	Eastern four fifty three turn right heading one eight zero	
0816:15	EA453	One eight zero four fifty three heavy	Granting ASO's request for a lower altitude would have been "a good move." The final controller normally controls airspace 5,000 ft and below. The only other aircraft in this stratum is EA630 at 4,500 ft.
0816:17	AR-V	Piedmont forty one contact tower now one one niner point five	
0816:21	PI41	We'll see you	
0816:23	ASO301	ASO three oh one lower please	
0816:26	AR-V	ASO three oh one turn left heading zero nine zero	
0816:29	ASO301	Zero nine zero ASO three oh one	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AS0301
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EA630
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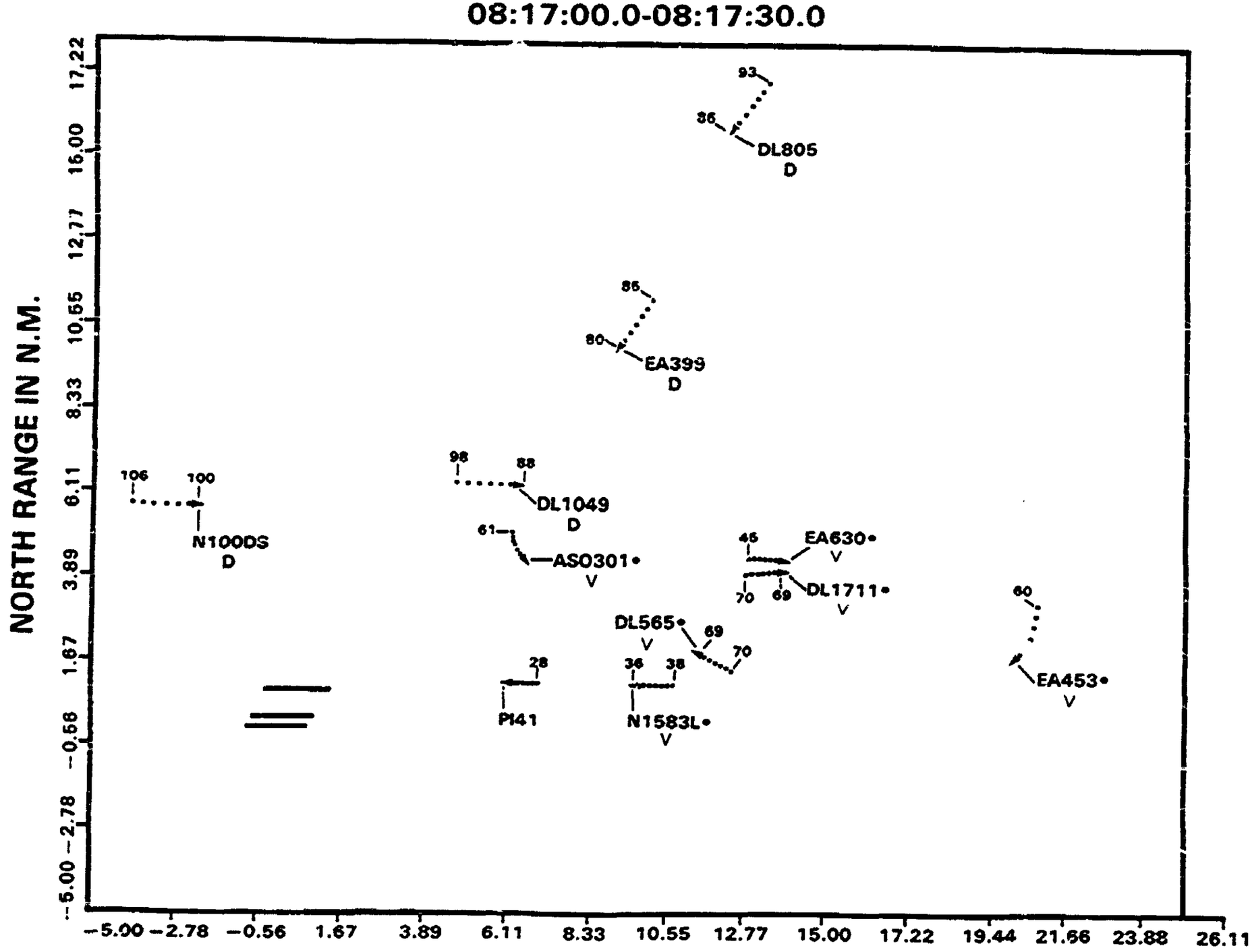
EAST RANGE IN N.M.

0816:36	AR-V	Eastern four fifty three heavy turn right heading two five zero proceed inbound on runway eight localizer	DL1711 and EA630 have altitude separation. DL1711 is descending to 7,000 and EA630 is maintaining 4,500. (EA630 is the aircraft that was taken out of the final approach when overtaking N5170U.)
0816:41	EA453	Two five zero (unintelligible) localizer	The turn 060°, issued to DL1711 could be considered to be a "delay vector" to place DL1711 behind EA630.
0816:45	AR-V	Roger	
0816:56	AR-V	Delta seventeen eleven turn left heading zero six zero	
0817:00	DL1711	Zero six zero	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NORTH RANGE IN N.M.
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-5.00
-5.00 -2.78 -0.56 1.67 3.89 6.11 8.33 10.55 12.77 15.00 17.22 19.44 21.66 23.88 26.11
EAST RANGE IN N.M.
93
86
DL805
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86
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EA399
D
106
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D
98
88
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D
61
ASO301
V
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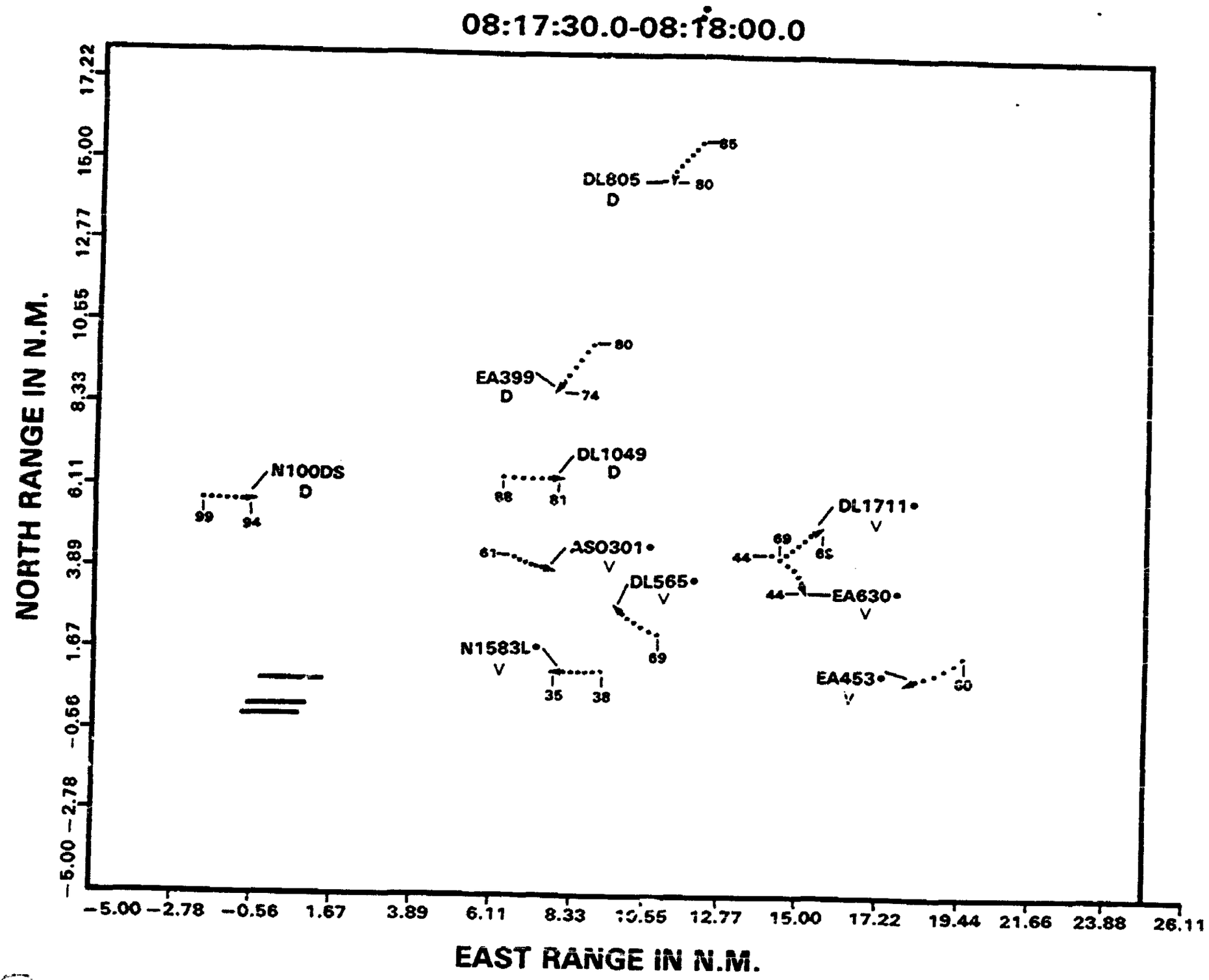
EA630
V
70
69
DL1711
V
DL565
V
69
70
28
P141
36
38
N1583L
V
60
EA453
V

0817:04	AR-V	Delta five sixty five say altitude now	EA630 is now being put on a base leg. The apparent decision was that between EA453 and EA630, EA630 will be ahead. EA630 could have been placed behind EA453, especially since EA453 is now intercepting the localizer.
0817:08	DL565	We're still at seven that's where we are cleared to	Looking at the present situation three dimensionally, DL1049 is descending to 7,000, DL565 is level at 7,000, and DL1711 is descending to 7,000. EA453 and ASO301 are at 6,000 ft. Unknown to the final controller, EA399 is also descending to 6,000 ft. EA630 is level at 4,500 ft.
0817:11	AR-V	Right	At 17:06.9 DL565 and DL1711 came within 2.55 nmi of each other. However, it should be noted that their courses are diverging and there was no conflict alert. Therefore, this is of relatively little importance.
0817:14	AR-V	Eastern six thirty turn right heading one eight zero	
0817:17	EA630	Eight zero Eastern six thirty	
0817:22	AR-V	And Delta five sixty five just maintain seven thousand for right now	
0817:27	DL565	Five sixty five I'd like to get a phone number to talk to somebody when we get on the ground please	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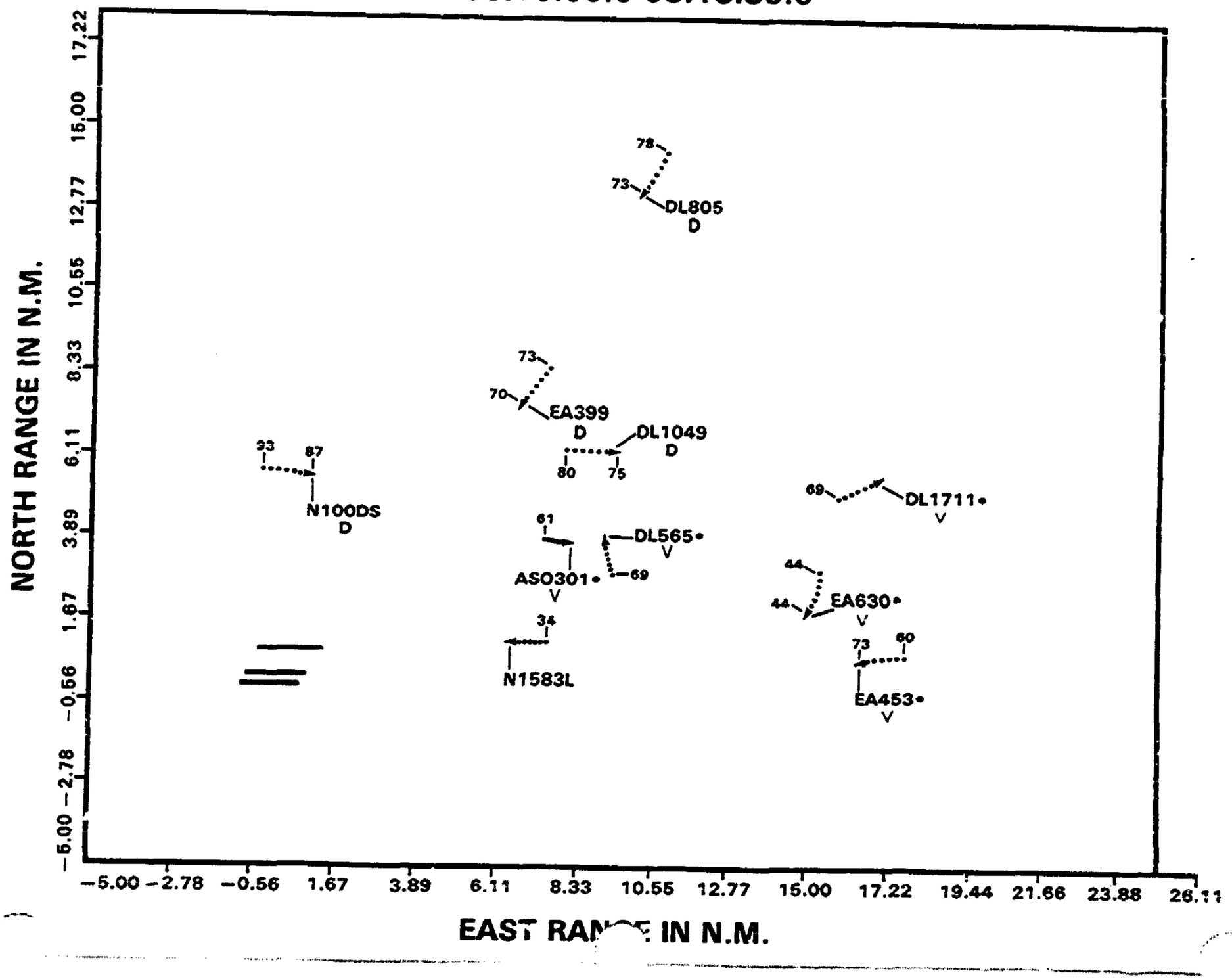
EAST RANGE IN N.M.

0817:[illegible]	AR-V	Roger	The feeder controller said that his first indication of any problem on the final radar position was when the supervisor told him to keep EA399. This most likely occurred before this (08:17:30 to 08:18:00) time frame. Neither the supervisor nor the feeder controller knew of the confliction between EA453 and DL565 which occurred at 08:15:[illegible]0.0 at an altitude of 7,000 ft. Again, it should be noted that the final controller normally controls altitudes of 5,000 ft and below.
0817:34	AR-V	I'll have that number for you in just a moment please	
0817:37	AR-V	Eight three Lima tower now one one niner point five	
0817:40	N1583L	Nineteen five so long	
0817:41	AR-V	Delta five sixty five turn right heading of zero six zero	
0817:45	DL565	Zero six zero five sixty five	
0817:52	AR-V	Eastern six thirty turn right heading two six zero	
0817:54	EA630	Two six zero Eastern six thirty	
0817:57	AR-V	Roger	
0817:59	AR-V	Eastern four fifty three heavy just continue inbound I might have to have a turn for you here shortly there break you out for traffic be turning in front of you there	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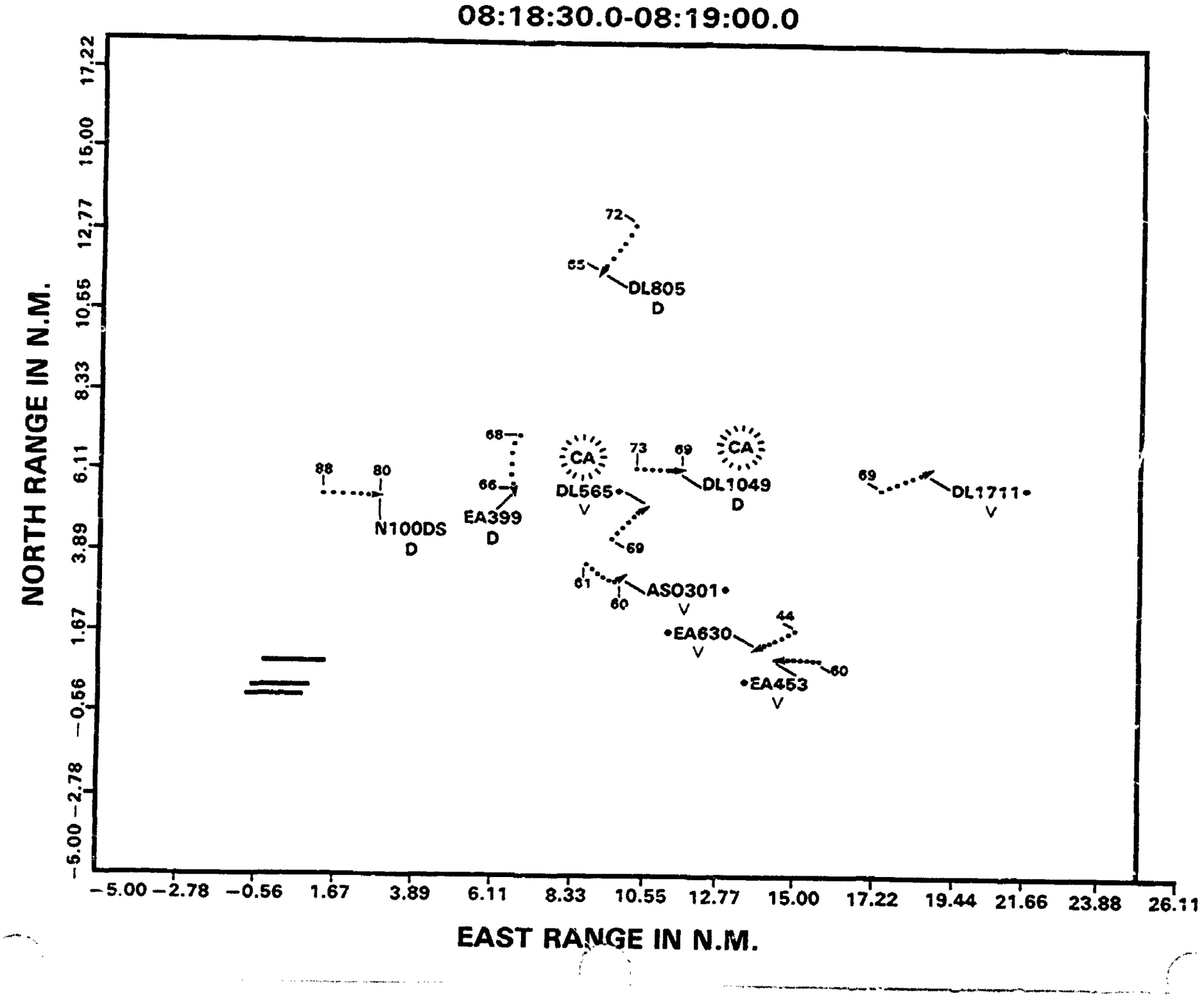
EAST RANGE IN N.M.

0818:06	EA453	Okay four fifty three we're still at six	Noting the symbology of "D" and "V" which is depicted below the aircraft identification, DL1049, EA399, N100DS, and DL805 are under control of the feeder controller. At 0818:23 the feeder controller told EA399 to turn left to a heading of 090.
0818:08	AR-V	Roger	
0818:08	AR-V	Eastern six thirty advise when airport in sight	EA399 and DL1049 came within 500 ft and 2.16 nmi of each other. It should be noted however, that at this point their courses are diverging and there was no conflict alert.
0818:12	EA630	We still got it Eastern six thirty	
0818:13	AR-V	Roger	
0818:15	AR-V	ASO three oh one turn right heading uh one eignt zero	
0818:19	ASO301	Okay uh how far are we from that seven twenty seven right there	
0818:25	AR-V	Okay that seven twenty seven is at seven thousand ft visual	
0818:28	ASO301	Roger that everything's okay	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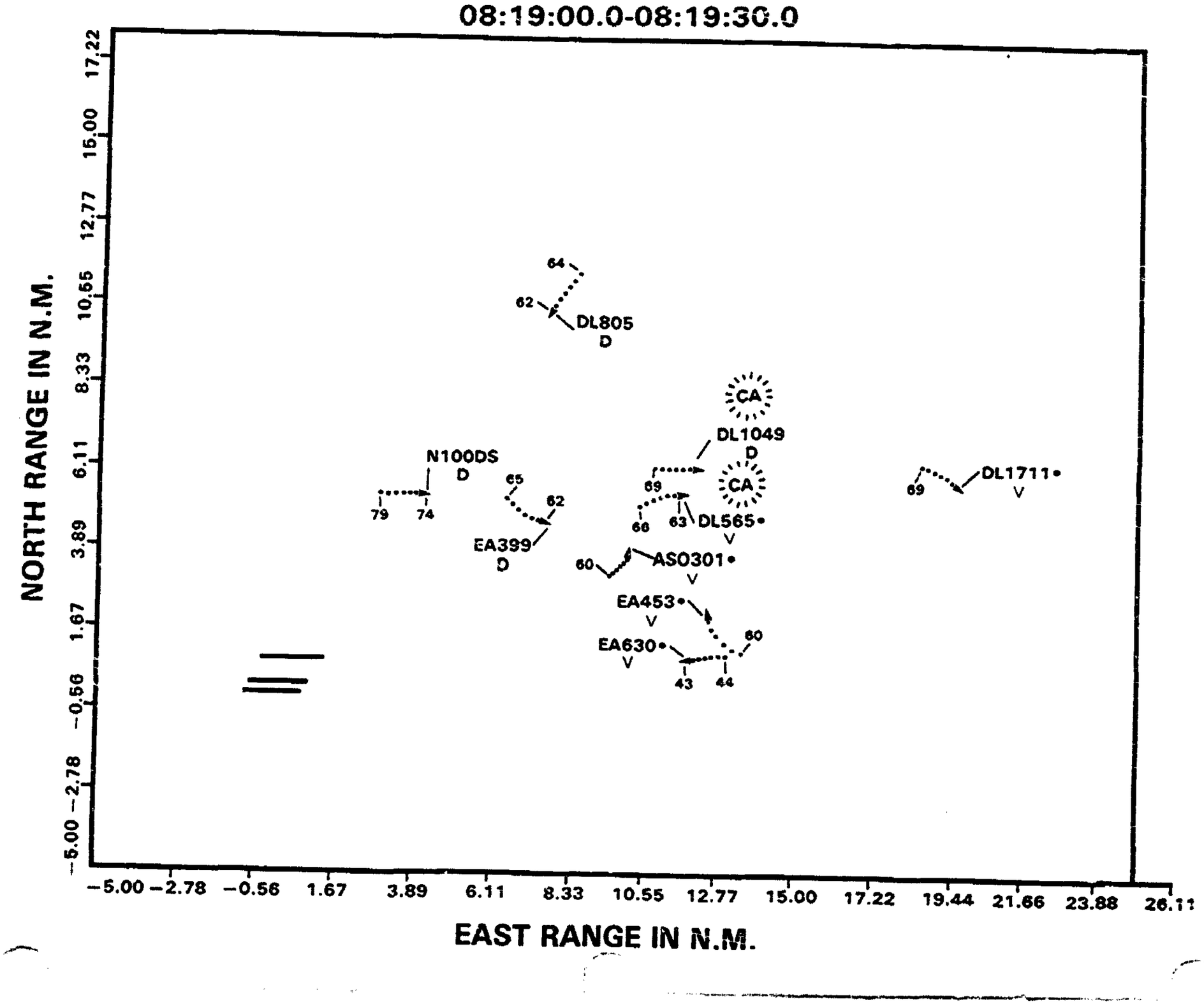
EAST RANGE IN N.M.

0818:31	AR-V	Okay ASO three oh one just disregard that fly heading of zero three zero make that zero three zero heading ASO three oh one	About the time that EA453 was issued the heading of 360, the conflict alert was activated for DL565 and DL1049. Delta 565 was then instructed to descend (correct action). At 08:19:17.9, the two aircraft came within 1.28 nmi and 500 ft of each other.
0818:37	ASO301	Okay back to the left to zero three zero ASO three oh one	
0818:42	AR-V	Eastern four fifty three turn right heading three six zero	
0818:45	EA453	Three six zero four fifty three	
0818:47	AR-V	Delta seventeen eleven turn right heading one eight zero	
0818:49	DL1711	Eight zero Delta seventeen eleven	
0818:51	AR-V	Delta five sixty five descend and maintain five thousand immediately	
0818:55	DL565	Five thousand five sixty five	
0818:58	AR-V	Eastern six thirty you have the airport in sight	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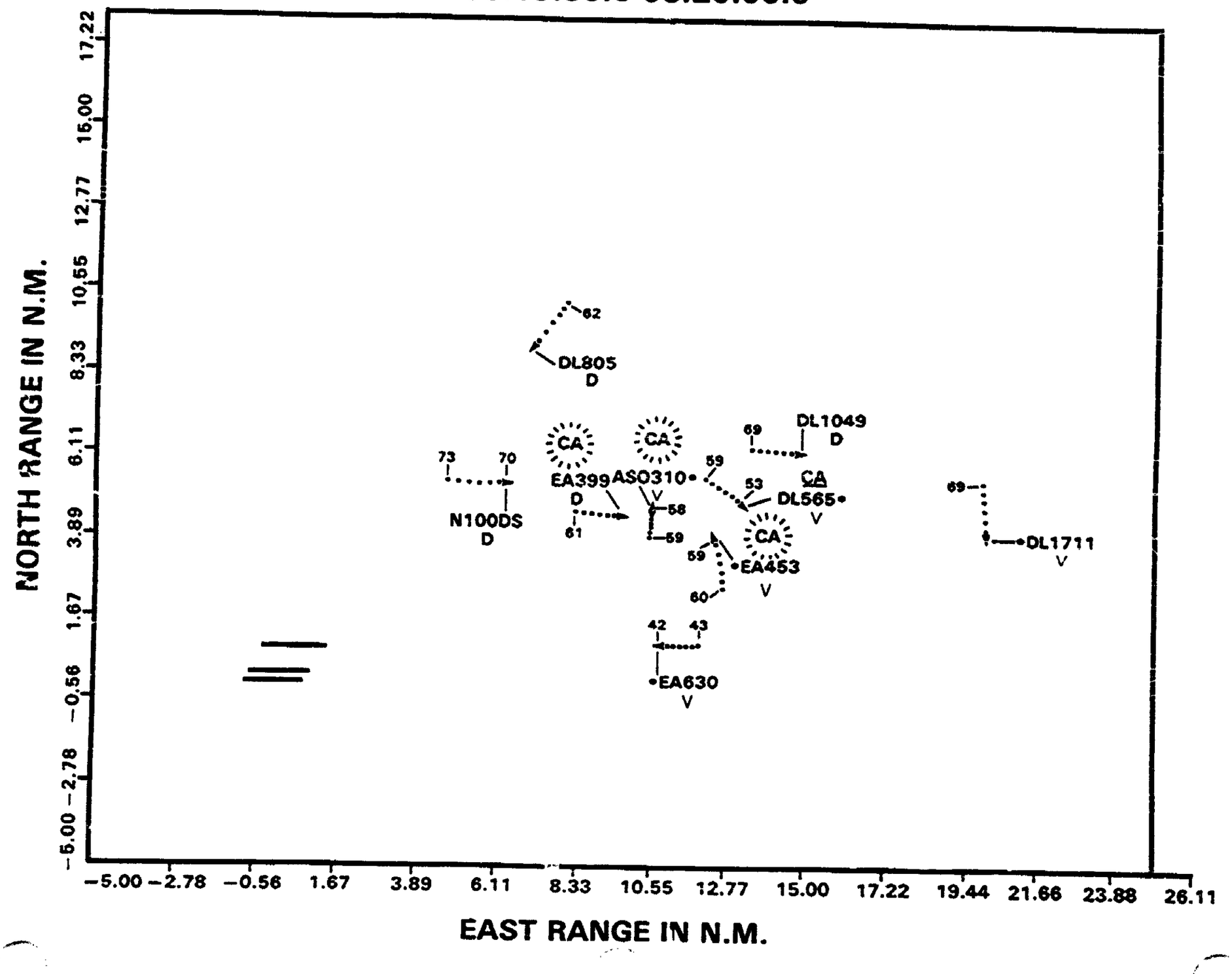
EAST RANGE IN N.M.

0819:00	EA630	Affirmative we still have it in sight	The data tag for DL1049 on the feeder controller's scope is flashing in the handoff mode with the conflict alert activated. The feeder controller did not recall seeing the conflict alert for DL1049 and DL565. At the end of this 30-sec sequence, separation is increasing. DL565 is leaving 6,100 ft descending to 5,000 ft.
0819:02	AR-V	Eastern six thirty cleared visual approach now to runway ah two six	Three aircraft, all at or descending to 6,000 ft are now converging--EA399, ASO301, and EA453. EA399 like DL1049 is one of the aircraft that was kept on the feeder controller's frequency because of the problems of the final control position. Because the feeder controller elected to "erase" data tags after the frequency change, DL565 did not appear on the feeder controller's scope until after the conflict alert was activated.
0819:07	EA630	Cleared visual two six Eastern six thirty	
0819:09	AR-V	Delta five sixty five turn right head one two zero	
0819:11	DL565	One two zero five sixty five	
0819:13	AR-V	ASO three oh one descend and maintain three thousand	
0819:16	ASO301	Three oh one down to three	
0819:18	AR-V	ASO three one one turn left heading three six zero	
0819:21	ASO301	Left for three oh one	
0819:26	AR-V	And Eastern four fifty three uh correction Delta five sixty five uh maintain five thousand good rate of descent please	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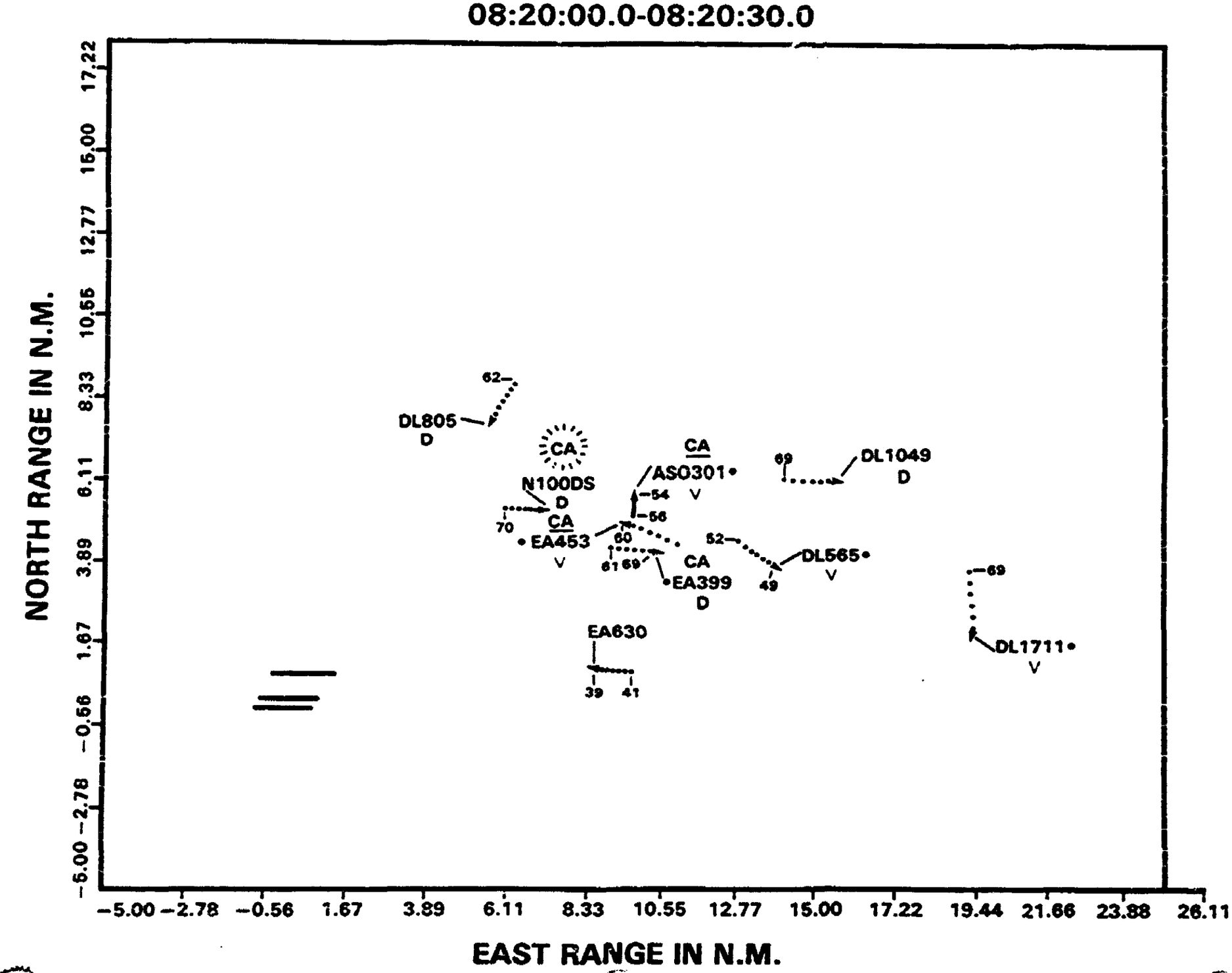
EAST RANGE IN N.M.

0819:33	EA453	Five thousand	At 08:19:52, EA399 reported to the feeder controller, "I got traffic crossing my bow here." EA399 was then instructed to climb immediately to 7,000.
0819:34	AR-V	Eastern four fifty three turn ri-- left now heading of three uh make that two nine zero	EA399 and ASO301 came within, 0.79 nmi and 300 feet of each other at 08:20:04.6. EA453 and DL565 came within 1.2 nmi and 600 ft of each other at 08:19:55. ASO301 and DL565 came within 2.2 nmi and 100 feet of each other at 08:19:36.
0819:40	EA453	I hope so two nine zero four fifty three	The conflict alert had been activated for EA399, ASO301, EA453, and DL565.
0819:46	EA453	What's going on	The data blocks associated with EA453 and ASO301 were not presented on the feeder controller's scope for the same reasons mentioned above for DL565.
0819:47	AR-V	Well uh little air little aircraft got me messed up there stand by just a moment please	
0819:55	AR-V	ASO three oh one get ready to descend down to four thousand please	
0819:58	ASO301	Okay you cleared us to three do you want us to stop at four	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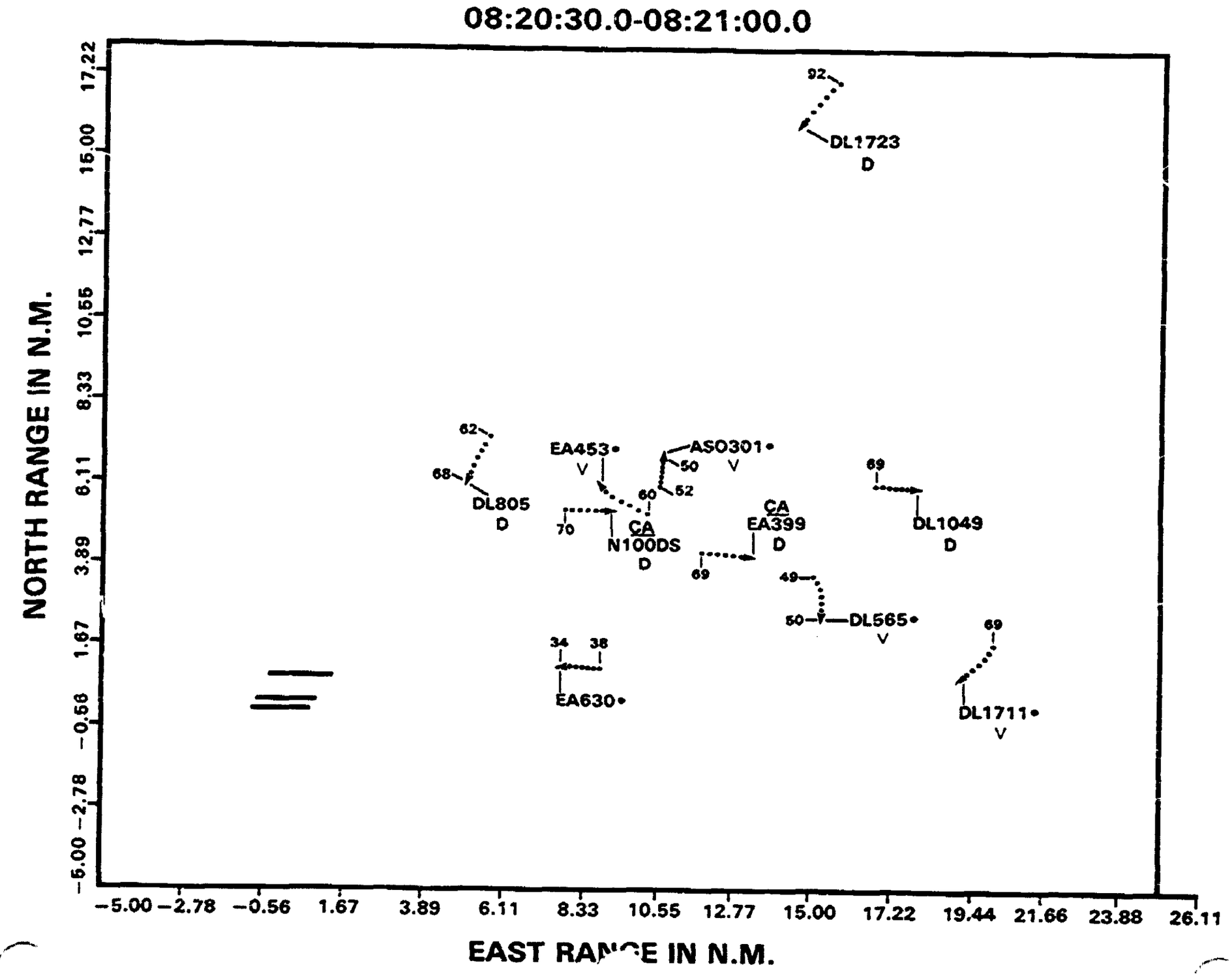
EAST RANGE IN N.M.

08:20:00	AR-V	At three thousand now please	On the feeder controller's frequency, when instructed to climb, EA 399 replied "Well that ain't gonna help that he's already past me. Then at 0820:14, EA399 told the feeder controller, "there's two of them in fact." EA 399 was then instructed to climb to 7,000 ft.
0820:02	AS0301	Okay	
0820:06	EA453	Four fifty three's gonna hold this heading we got a airplane just to our left on a collision course	
0820:11	AR-V	Four fifty three roger maintain your heading then I got a lot of traffic there in the vicinity of ya	EA399 and EA453 came within 600 ft and 0.62 nmi at 08:20:18.6. The conflict alert had activated.
0820:16	EA453	We see it all	
0820:17	AR-V	Ah roger thank you	
0820:18	AR-V	Delta seventeen eleven proceed inbound on localizer runway two six	At 08:20:22.9, DL805 and N100DS came within 2.7 miles and 800 ft of each other. The conflict alert had activated. However, their courses were diverging at this point, so the decrease in separation is relatively unimportant.
0820:21	DL711	On the localizer Delta seventeen eleven	AS0301 and EA453 came within 600 ft. and 0.82 nmi of each other at 08:20:32.5. The conflict alert on these data tags had also activated.
0820:23	AR-V	Delta five sixty five turn right heading of two six zero a tight turn	
0820:27	DL565	Left two sixty five sixty five	
0820:29	AR-V	Eastern three ninety nine you with me	During this time period, the conflict alert activates on N100DS, stops on ASO 301, and continues on EA399.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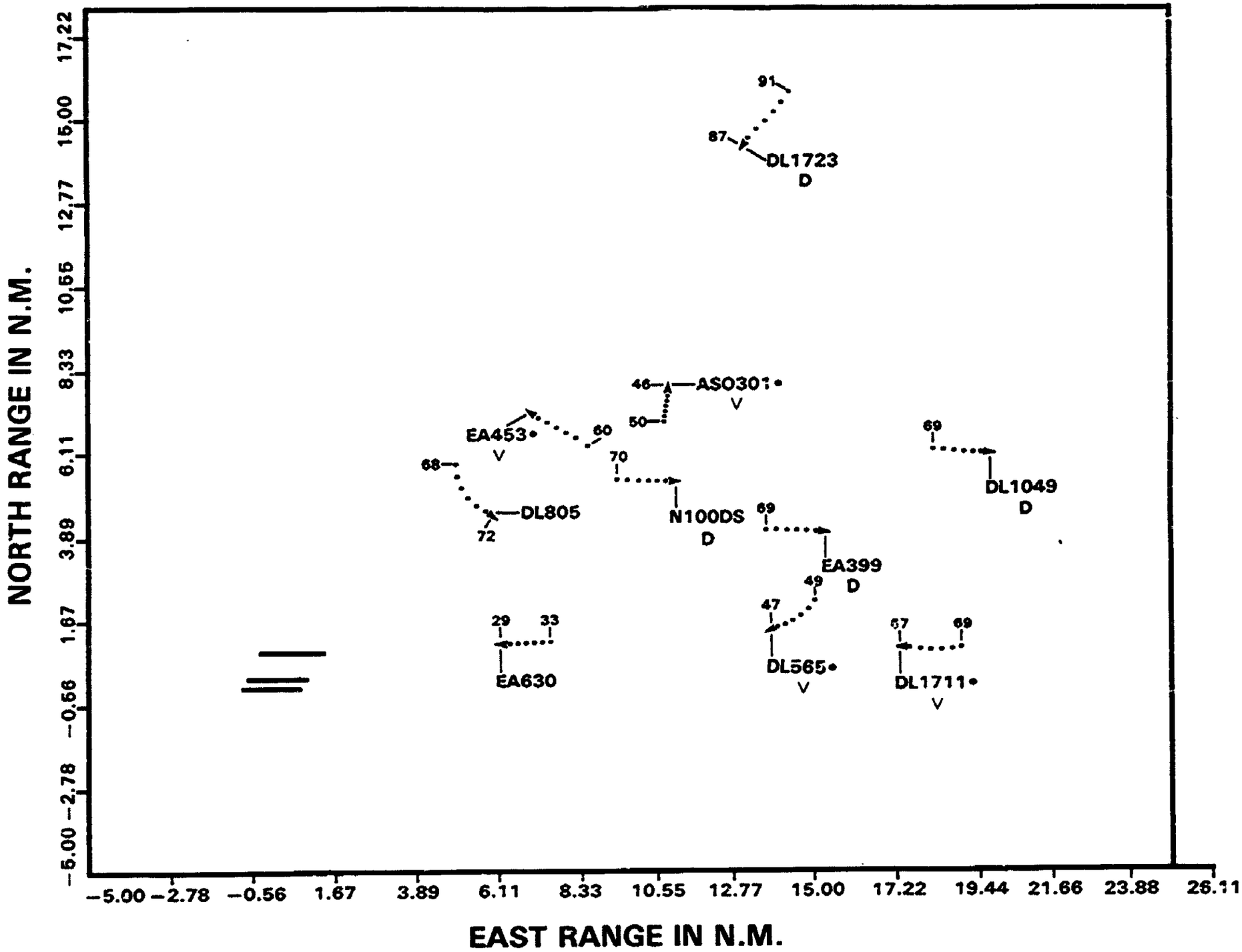
EAST RANGE IN N.M.

0820:39	AR-V	Eastern three ninety nine turn left heading zero six zero	
0820:46	AR-V	Eastern three ninety nine turn left heading zero eight uh zero seven zero.	
0820:54	AR-V	Delta seventeen eleven advise the airport in sight	
0820:57	DL1711	Got it	
0820:58	AR-V	Okay Delta five sixty five advise when the airport in sight now	During this time period ,the conflict alert stops on EA399 and N100DS.

08:21:00.0-08:21:30.0

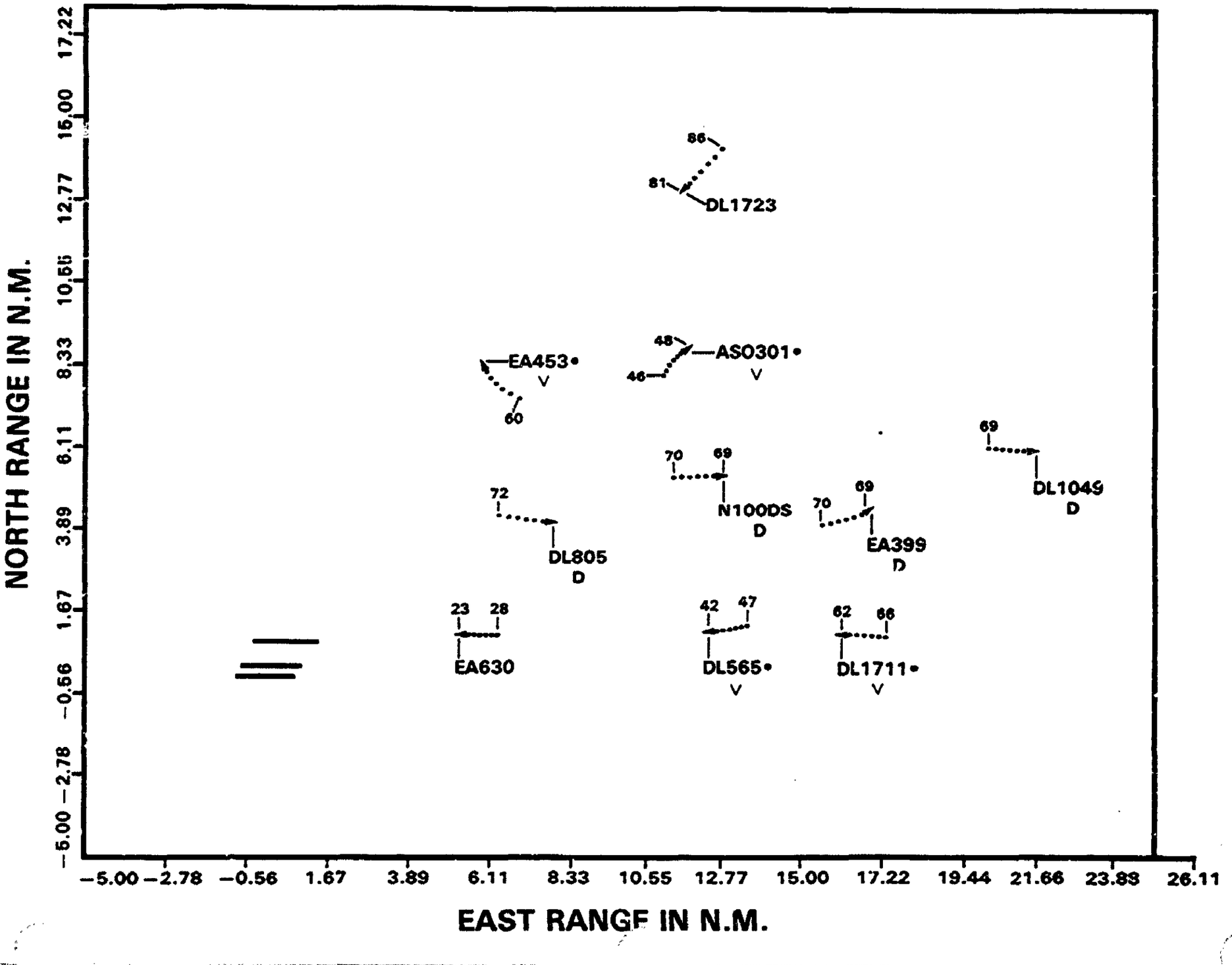


0821:01	DL565	We have it
0821:02	AR-V	Delta five sixty five clear visual approach runway two six
0821:05	DL565	Five sixty five cleared visual
0821:07	AR-V	Delta seventeen eleven cleared visual approach runway two six advise you pick up company traffic a Delta at twelve o'clock to you now four miles westbound
0821:15	DL1711	We got it
0821:16	AR-V	Roger
0821:17	AR-V	Delta ten forty nine heavy turn right heading one eight zero
0821:23	AR-V	Delta ten forty nine heavy you with me
0821:26	AR-V	ASO three oh one turn right heading zero nine zero
0821:29	ASO301	Zero nine zero three oh one

<u>The following conversation is from the feeder controller's position:</u>

0821:02	EA399	Approach Eastern three ninety nine
0821:04	TAR-D	Yes sir Eastern three ninety nine
0821:06	EA399	We're at seven thousand feet what altitude was that ten eleven at.
0821:17	TAR-D	Ah Eastern three ninety nine I couldn't see right at the minute turn left heading zero seven zero for just a minute
0821:24	EA399	Seventy degrees three ninety nine
0821:30	TAR-D	Ten eleven is at seven thousand feet he's seven miles ahead of ya

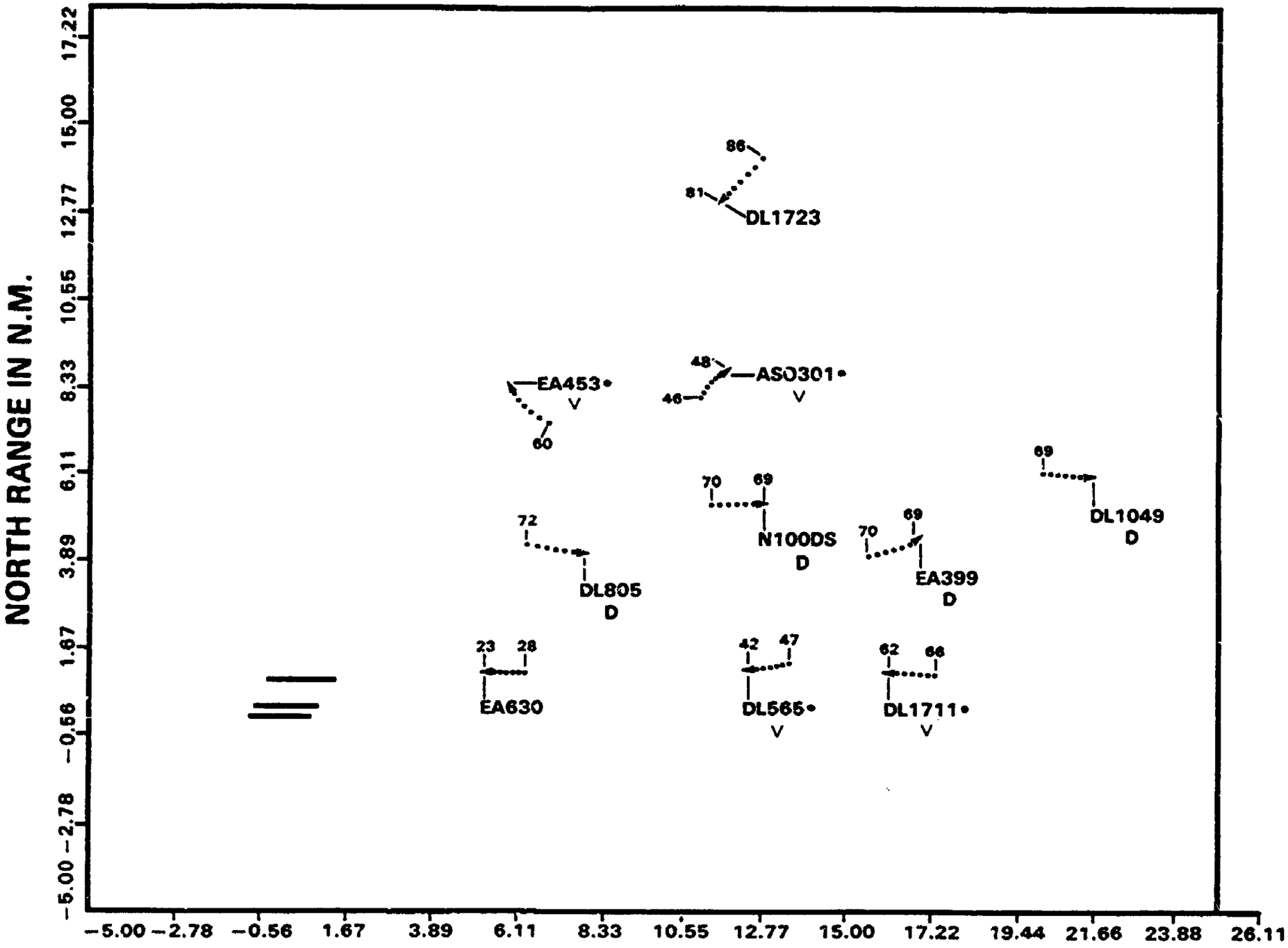
08:21:30.0-08:22:00.0



0821:31	AR-V	Eastern four fifty three heavy turn right heading zero niner zero
0821:34	EA453	Okay turn right zero nine zero four fifty three
0821:38	AR-V	Okay Delta ten forty nine heavy you with me
0821:41	AR-V	Eastern six thirty contact tower now one one niner point five
0821:45	EA630	Six thirty
0821:46	AR-V	Delta five sixty five tower one one niner point five at the marker
0821:50	DL565	Five sixty five
0821:53	AR-V	Eastern three ninety nine you with me

From the feeder control position:

0821:35	EA399	I'm not talking about that one I'll call ya on the ground give me a number
0821:40	TAR-D	Roger seven six one seven three three Eastern three ninety nine
0821:45	EA399	Seven six one say again the last four
0821:47	TAR-D	Seven seven three three
0821:51	EA399	And who shall I ask for I don't want to talk to somebody who don't know what was going on
0821:54	TAR-D	Alright just ask for the watch supervisor Eastern three ninety nine
0821:57	EA399	Alright
0821:58	TAR-D	Delta ten forty nine heavy turn left heading three six zero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EAST RANGE IN N.M.

0822:09	AR-V	ASO three oh one turn right heading of two four zero	The traffic now appears to be well separated. The controller is relieved by the team supervisor after the 08:23:02 transmission.
0822:12	ASO301	Two four zero ASO three oh one	
0822:27	DL565	Got a phone number for Delta five sixty five	
0822:30	AR-V	Uh seven six two seven six oh four	
0822:32	DL565	Thank you	
0822:44	AR-V	Delta seventeen eleven if feasible reduce speed now to one six zero so you can hold four miles on the traffic ahead of you	
0822:50	DL1711	Okay we're at one fifty five now	
0822:51	AR-V	Ah roger and you got three miles on your traffic	
0822:59	AR-V	Eastern three ninety nine you with me	
0823:02	AR-V	Zero Delta Sierra you with me	

(Controller relieved by Team Supervisor at this point)

Review of Evidence with Involved Controllers

During the Safety Board's investigation, the circumstances and chain of events depicted on the Segmented Aircraft Movement Charts was discussed with those controllers who had been on duty at the time.

The approach control supervisor, who was not working with his normal crew, stated that the south final sector normally "starts to get busy first, about 8:00," and that the north side "built fairly regular." Consequently, when he observed that the south side final was busy, extending out to 18 miles, he told the south final controller to give the two VFR general aviation aircraft (N5170 and 1583L) to the north final controller. He pointed out both aircraft to the north final controller but he was not certain that he pointed them out to the north feeder controller. He subsequently realized that the north side final controller had a problem when EA 630 was taken out of the sequenced pattern. He then stopped traffic from Atlanta Center. He stated that he would expect a controller on his team to call him if help was needed. Such calls are infrequent, perhaps once a year.

The north final controller stated that the two general aviation aircraft which were handed off from the south final controller were "giving him a problem." N5170U "didn't turn in as he was supposed to" and he believed that this created a sequencing problem with EA 630. With regard to the first conflict between EA 453 and DL 565, he stated that he was aware of the aircraft and had expected or "pictured" EA 453 going below DL 565. He recalled that the data tags for the two aircraft overlapped and that he was not aware of DL 565's altitude, although he assumed it to be descending to 6,000 feet (the feeder controller had actually stopped DL 565's descent at 7,000 feet). He did not remember the activation of the conflict alert between EA 453 and DL 565 but stated that his attention during this time was drawn to the situation involving N5170U which included some difficulty in understanding air-to-ground radio transmissions. He described his workload at that time as moderate and starting to get heavy.

He stated that he became aware of the proximity of EA 453 and DL 565 after their flightpaths had crossed. He then recalled the problem of sequencing N1583L, the second general aviation aircraft with DL 565. He was aware also that the supervisor had told other controllers not to pass him more aircraft.

He recalled the subsequent conflict and associated alerts, and although he did not remember the specifics of the situation, he did remember that data tag overlap was a problem between EA 399 and ASO 301. He believed that the conflict situation was "mostly cleared up" when the supervisor took over his position.

The final controller also observed that there are no "cut and dried procedures" for aircraft position or altitudes being handed off from the feeder controller at Atlanta. He further noted that the conflict alert was of no help to him in this situation. When he finally realized that he needed help, he was too involved to ask. He acknowledged that help is available if one raises his voice, but that "when you're working final you're on your own and you do the best that you can."

The feeder controller, who also was not working with his regular team, classified his workload as being "not busy" during the period leading to the conflicts. He considered it to be a standard operating practice for his team to descend traffic entering downwind to 7,000 feet and traffic entering base to 6,000 feet. However, because of

other traffic (ASO 301), he stopped DL 565's descent at 7,000 feet. He did not advise the final controller of this deviation nor did he believe there was reason to do so. He observed that DL 565 should have gone into the automatic handoff status at 25 miles from the airport (handoff to the final controller) and he had told DL 565 to change to the final controller's frequency before reaching this "boundary." He did not recall the final controller's acceptance of the handoff, but he considers the acceptance of a "flashing handoff" (the data block flashes on and off until acceptance by the receiving controller) to be a low priority. While working the feeder position, he routinely sets his filter limits 2/ so that only the altitudes of the aircraft in the radar controller's airspace are displayed. He was, thus, not aware of the impending conflict between EA 453 and DL 565, nor could he recall the activation of the conflict alert at that time. He first became aware of a problem on the final radar position when the supervisor told him to keep EA 399 under his control and on his frequency. Until that time, he believed that the final radar position was "not very busy." He was not aware, however, that the two general aviation aircraft had been handed off to the final controller, and he did not believe that he needed to be aware of such traffic conditions.

All three controllers commented on the effectiveness of the low altitude/conflict alert. They believed that the frequency of activation of the audio alarm, which is the same for both low altitude (terrain) and conflict situations, tends to desensitize the controllers. They noted that there is a stronger tendency among controllers to disregard the alert during visual meteorological conditions.

The training of the controllers assigned to the Atlanta Tower is similar to that of controllers at other FAA high density terminal area facilities. However, all Atlanta controllers have had experience in other facilities before their assignment to Atlanta. Upon initial assignment to Atlanta, a controller is given about 40 hours of classroom instruction on local airspace and procedures unique to the facility. After completing the classroom instruction, a controller is then considered to be in a training status and is assigned to a team. The trainee is given daily on-the-job training working with experienced controllers, one or two of whom are assigned as instructors. The instructors are responsible for both the training and the evaluation of the new controller's performance in one or more of the specific tower control positions. When the instructor is satisfied that the new controller is able to handle safely the function of a position by himself, the controller is given a check and certified in that position. Following the initial checkout, a controller is subjected to periodic over-the-shoulder evaluations of his on-the-job performance in handling live traffic at the position. An evaluator's assessment of a controller's ability and performance is strictly subjective. In addition to the over-the-shoulder evaluations, a controller undergoes proficiency refresher training and a check annually. This includes classroom refresher as well as simulator training in which the controller may be required to demonstrate the knowledge and the ability to handle emergency situations and seldom-used procedures. In the Atlanta facility, simulated traffic can be introduced into the ARTS-III computer and presented to the controller along with the actual traffic in his sector. The Safety Board's investigation disclosed that there are some limitations to the use of such simulation as a result of the priorities associated with a high density traffic environment.

2/ Filter Limits - Determine the altitude stratum of the targets shown on the radar display. For example, if filter limits are set at 050-130, all traffic in the system that does not have a data tag associated with it, but is transmitting a transponder code with altitude encoding, will present a limited data block if the aircraft is somewhere between 5,000 and 18,000 feet.

Each controller in the Atlanta facility was expected to be certificated for all of the tower cab and radar room positions. Once achieved, a person is designated as a full-performance controller. As such, he is then assigned to each of the control functions at the Atlanta Tower, the assignments rotating so that each function is worked at least once a week.

The approach control supervisor on duty at the time of the incidents had been employed by the FAA in 1963 and had been at the Atlanta Tower since 1967, except for a 2-year assignment in Orlando, Florida. The feeder controller had been with the FAA for almost 23 years, the last 13 of which had been at the Atlanta Tower.

The final controller, age 38, had been with the FAA for almost 10 years, having reached the full-performance level in about 5 1/2 years. Before his assignment to the Atlanta Tower 6 years ago, he had worked as a controller at Winston-Salem, North Carolina, and in the tower at Birmingham, Alabama. On the day of the incident, he had a current medical certificate and he was fully certified in the final control position; he was due for proficiency refresher training, his last proficiency check having been given in October 1979. On January 19, 1980, he was decertified on the ground control position because he had "problems keeping up," and was given subsequent training. Following additional training, he was recertified on the ground control position. During the span of a year, he had received five airspace briefings, the last of which was on June 6, 1980. He was given an over-the-shoulder evaluation on September 15, 1980, in which he was critiqued for phaseology and planning. His performance was "fully acceptable." He had had no systems errors 3/ in the last 2 years.

On October 7, 1980, each of these controllers had been assigned and worked the 7:30 a.m. to 3:30 p.m. shift.

DISCUSSION

The Safety Board believes that several factors contributed to the situation which resulted in aircraft passing without required separation in Atlanta on October 7, 1980--(1) Control procedures and controller technique, (2) equipment and facilities, (3) the conflict alert system, and (4) controller selection and training.

Controller Procedures and Technique

The first element in the chain of events was the supervisor's decision to handoff the two general aviation aircraft to the north final controller. This decision was neither unusual nor unreasonable. The feeder controller stated that he was not aware that these two aircraft had been placed in the final controller's airspace. The feeder controller did not consider it necessary that he be apprised of such traffic. However, had he been aware of the additional traffic, he may not have changed DL 565 to the final controller's frequency without handoff acceptance by the final controller. (The act of turning an aircraft over to the final controller without handoff acceptance was a serious error on the part of the feeder controller.) Furthermore, additional workload in the final sector can back up to create a problem for the feeder controller. The Safety Board believes that when traffic is handed off to a final controller from other than the normal feeder source, the handoff should be pointed out to the feeder controller, particularly during busy periods, so that the final controller will not be overloaded by the feeder controller.

3/ An occurrence in the air traffic control system which results in less than the applicable separation between two or more aircraft or between an aircraft and terrain or obstacles and obstructions.

The Safety Board does not believe that the addition of the two general aviation aircraft should have presented a difficult control problem to the final controller with the existing traffic density. Rather, the Board believes that the control technique used by the final controller was improper. The final controller should have been able to project the flightpaths of N5170U and EA 630 with their relative speed differential and foresee the problem much sooner than he did. Had he selected a different control solution, (e.g., speed control of faster aircraft and keeping slower aircraft close to the airport) the attention required to handle N5170U would have been much less. He then could have given the needed attention to the rest of his radar display, thereby detecting the impending conflict situation between EA 453 and DL 565.

With regard to this conflict, however, the Safety Board recognizes that human operators will not always exercise faultless control. For this reason, procedures which will minimize the potential for conflict as a result of human error should be formulated. The feeder controller was handing off traffic to the final controller from two corridors, aircraft entering from the northwest on downwind, and aircraft entering from the northeast onto the base leg. This created the potential for conflict. Atlanta had no specific procedures stating how the converging traffic should be handled. The procedure generally used by this team was for the final controller, following handoff acceptance, to be responsible for assuring separation between aircraft arriving from both corridors. (The feeder controller was not a regular member of this team.) During the investigation, the Safety Board learned that some teams stop their downwind (from the northwestern corridor) traffic at 7,000 feet and have the base-leg traffic (from the northeastern corridor) at 6,000 feet, thus providing vertical separation until the final controller can establish sequencing horizontally. Whatever method chosen, either through written, established procedure or through verbal agreement at the start of a shift, traffic separation should be assured before aircraft are turned over to the final controller.

With no established procedure in effect, regarding convering traffic from two corridors both controllers--feeder and final--should have been extremely cautious. The feeder controller should have monitored his airspace closely until aircraft that had been handed off to the final controller had vacated the feeder controller's altitudes. (In the area where the near-collisions occurred, the final controller is normally responsible for the altitudes of 5,000 feet and below. The feeder controller is normally responsible for 6,000 to 11,000 feet.) The final controller should also have been monitoring the airspace in which he normally receives handoffs from the feeder controller, knowing that at any time he could receive aircraft that, unless he took control action, would be in conflict at 6,000 or 7,000 feet.

Another procedural shortcoming occurred when the feeder controller failed to verbally communicate that DL 565 had been assigned 7,000 feet instead of the normal 6,000 feet.

A further degradation of the control situation following the first conflict between EA 453 and DL 565 was caused by the controller being unable to keep abreast of the changing traffic situation, coupled with poor control procedures and technique. All the remaining conflicts occurred with aircraft that the final controller should have descended. These conflicts involved aircraft under control of both the feeder and final controller which were at or near the same altitude.

When the final controller accepted control of aircraft at 6,000 and 7,000 feet from the feeder controller, he was obligated to keep those aircraft on a normal flightpath until the aircraft had descended into the altitudes, 5,000 feet and below, that he normally controlled. This was not done. EA 453, DL 565, and ASO 301 all had their direction

changed and were given 360° turns without the required proper coordination with the feeder controller. Paragraph 703 of the Air Traffic Control Handbook states that "Until the aircraft is in your area of jurisdiction, obtain the transferring controller's approval before changing the heading, altitude, speed. . . ."

Conversely, good control procedure dictates that if the feeder controller is normally responsible for 6,000 to 12,000 feet in a particular area and hands off an arriving aircraft to the final controller at 7,000 feet, then the feeder controller has relinquished both 6,000 and 7,000 feet and cannot use these altitudes until they are vacated. After handoffs had been accepted by the final controller, the data tags were removed from the feeder controller's scope. As a result, DL 1049, EA 399, and N100DS were vectored into an area at 6,000 and 7,000 feet which the feeder controller thought was "his" area, but in actuality contained aircraft still being worked by the final controller at 6,000 and 7,000 feet.

If a control situation becomes complex and begins to cause a controller to concentrate on one problem to the exclusion of the rest of the display, the controller should readily recognize the situation and either ask for help or limit the traffic entering his area. The final controller did neither.

In order for the air traffic control system to be truly "safe," multiple safeguards must be provided. In this sequence of near collisions, at least the following safeguards should have existed: (1) altitude separation of converging traffic from the two "feeder corridors"; (2) the feeder controller's monitoring of traffic until it has left his area of jurisdiction; and (3) the requirement for a controller to coordinate flightpath changes when given to an aircraft in another controller's airspace.

Equipment and Facilities

The final controller stated several times during the investigation that data tags overlapped and as a result he could not see altitudes. Because of this, the Safety Board requested that the FAA Technical Center provide a playback of events as seen on the final controller's display. The only conclusion that one may draw from the playback was that with the display set the way that an Atlanta TRACON controller might normally use it, there would have been some data tag overlap. Specifically where, or to what extent overlaps occurred could not be determined. However, it should be noted that the final controller made no effort to alter the presentation on his scope to lessen the degree of data tag overlap, which he could have done.

The physical location within the radar room of the two sectors involved merits discussion. The north feeder and north final controller are situated on the same side of the radar room about 30 feet from each other; the north final and south final positions are located next to each other. Because the traffic that the feeder controller works eventually becomes the traffic of the final controller, logic dictates that the placement of succeeding controllers next to one another would allow direct communication between them without the added step of using an interphone. During the investigation, the Safety Board learned that the operations chief had recommended nearly 2 years before this incident that these position locations be changed but for some reason no corrective action had been taken.

Conflict Alert

Although the conflict alert functioned as intended, there was only one instance in which the conflict alert stimulated the controller to take corrective action--when

DL 565 was told to descend to 5,000 feet. All of the conflict alerts involved at least one aircraft whose data tag was in a handoff status--the information inside the data tag was flashing on and off on both controllers' displays. When an aircraft in the handoff status comes into conflict with another aircraft, the only addition to the flashing data tag is the two small letters, "CA," on top of the data block, flashing at the same rate and intensity as the rest of the data block. If the letters alone were flashing, they might be conspicuous; they are not as conspicuous, however, when the data tag is already flashing.

The conflict alert also has an audio alarm. This audio alarm is the same as that used for the low altitude alert. On a day when the weather is good and visual approaches are in use, the low altitude alert activates frequently. The Safety Board investigators observed that on such a day, during a 10-minute period in the radar room, the low altitude alert activated three times. Additionally, since the audio alarm comes from one source in the radar room, all controllers are able to hear it whenever it activates. Additionally, the frequency of conflict and low altitude alerts should be considered. This situation and the others mentioned above results in repetitive alerts which, in turn, condition the controller to dismiss the alarms or alerts (i.e. the "cry wolf" syndrome). The Safety Board believes that improvements are needed in both the audio and visual cues for the low altitude and conflict alert systems.

The supervisor was watching a combination of data blocks and control symbols with the conflict alert feature not available at his position. Thus, if a conflict alert occurred, he might hear the alarm but would not know which aircraft were involved. The ARTS III automation should be configured so that when a supervisor is watching a display he can see any conflict alerts in the area he is supervising. The first conflict alert occurred at 8:14:37 and the final controller was not relieved until 8:23--too long a period of time. Had the conflict alert been displayed on the supervisor's scope this time period might have been significantly reduced.

Controller Selection and Training

The ability to "mentally project" targets of different speeds and to visualize where these targets will be in a given amount of time, is a basic skill for a radar controller. Based upon his handling of traffic, as described in this report, the final controller appeared to be deficient in this basic skill, as well as in his ability to utilize altitude separation and speed adjustment. An incident or near-collision should not have to occur to reveal these deficiencies. The Safety Board is concerned that the evaluation of a controller's ability to resolve complex control situations and keep up with the flow of traffic is mostly subjective. Therefore, factors such as personalities, friendships, and current workload could influence an evaluator's judgment.

During the investigation of this incident, Safety Board investigators examined the simulation capabilities of the Atlanta Tower's air traffic control computer and determined that due to functional limitations it would be of little use in teaching or testing the abilities of controllers to "mentally project" targets of different speeds and to work complex control problems. The priority afforded the simulation program was so low that targets moved only when the computer had time to move them. A target that had been entered with a speed of 250 knots moved the distance that a 125-knot target would move with one "sweep" of the radar but then with the next "sweep" of the radar, the target would jump the equivalent distance of a 400-knot target. The simulator does, however, serve a very useful function in reproducing various types of simulated emergencies which do not occur on a regular basis so that a controller's technique in handling emergency situations may be kept current.

The current practice of observing a controller in an over-the-shoulder evaluation while that controller works "live" traffic does not provide a reliable method for detection of basic deficiencies because the examiner cannot "set up" various situations designed to measure controller skill. The Federal Aviation Administration's Radar Training Facility and Employee Selection and Training Manual (Document No. FAA-AM-80-15), dated September 1980 states that the FAA has recently constructed a radar training facility in Oklahoma City, Oklahoma. This facility uses a rather sophisticated air traffic control simulator that could be used to determine the basic skills of air traffic controller trainees as well as the ability of rated controllers to work complex traffic situations. The Safety Board believes that, considering all of the techniques possible with present computer technology, all facilities having sufficient traffic to warrant automated radar should also have simulators capable of completely training and testing radar controllers. This "training system" could eliminate any subjective judgments concerning a controller's ability. Additionally, the Safety Board believes that periodically all controllers at the journeyman or full-performance level should be tested and required to meet a certain minimum skill level. This process too should be devoid of any subjective judgments.

Extraction of Radar Computer Data as a Training, Evaluation, and Investigation Tool

During the development of its automated radar, the FAA's Research and Development (R&D) staff recommended that playback ability be included as part of the computer program, but FAA management did not adopt the recommendation. As a result, the FAA is able to recreate a complex traffic situation only at a few terminal facilities. This is accomplished via tedious hand plotting of aircraft positions by reference to a computer printout of system coordinates of latitude and longitude. Although the 30-second Segmented Aircraft Movement Charts represent a vast improvement over this, the best tool for both investigation and training would be the instant playback ability originally proposed by the FAA R&D staff.

FINDINGS

1. Between 8:15 and 8:21 a.m., e.s.t. on October 7, 1980, under clear skies with 15-mile visibility, a series of near collisions involving five aircraft occurred in the terminal control airspace at Hartsfield International Airport, Atlanta Georgia.

2. The near collisions were the result of inept traffic handling by certain control personnel. The ineptness, in turn, was attributable in part to inadequacies in training, procedural deficiencies, and some difficulties imposed by the physical layout of the control room.

3. The control technique of the final controller involved in this investigation was generally deficient.

4. The current system of training available in terminal facilities does not facilitate the identification and correction of deficient techniques.

5. The feeder controller failed to continue monitoring aircraft handed off to the final controller until the aircraft had vacated altitudes normally controlled by the feeder controller.

6. The feeder controller imposed an aircraft on the final controller without the latter having accepted the handoff.

7. The final controller failed to coordinate with the feeder controller when he turned traffic back into traffic that the feeder controller was working. Such coordination is not facilitated by the physical layout of the control room which does not provide for direct communication and ease of coordination between closely interacting control positions.

8. Control of two general aviation aircraft was transferred from the south final controller to the north final controller following coordination by the supervisor. The north feeder controller was not advised of this transfer.

9. The final controller had an overlap of data tags on his display. The extent of this condition could not be determined.

10. The supervisor's display lacked the capability of displaying conflict alerts. Had the supervisor's display had this capability, he would have been alerted to the conflicts sooner.

11. The design of the low altitude/conflict alert system contributed to the controller's not recognizing the conflicts. The flashing visual conflict alert is not conspicuous when the data tag is also flashing in the handoff status. The low altitude warning and conflict alerts utilize the same audio signal which is audible to all control room personnel rather than being restricted to only those immediately concerned with the aircraft. This results in a "cry wolf" syndrome in which controllers are psychologically conditioned to disregard the alarms.

RECOMMENDATIONS

Based on this investigation, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Upgrade the simulation program at terminal facilities equipped with automated radar so that radar training and testing may be accomplished mainly via simulation. Consideration should be given to a system similar to that at the FAA's radar training facility in Oklahoma City. (Class II, Priority Action) (A-81-132)

When an improved simulation system is acquired at terminal facilities, require controllers to periodically demonstrate a predetermined level of skill similar to the manner in which the FAA requires air carrier pilots to demonstrate proficiency on aircraft simulators. (Class II, Priority Action) (A-81-133)

Redesign the low altitude/conflict alert at ARTS III facilities so that the audio signal associated with the low altitude alert is readily distinguishable from that associated with the conflict alert and heard only by controllers immediately concerned with the involved aircraft. (Class II, Priority Action) (A-81-134)

Redesign the low altitude/conflict alert system at ARTS III facilities so that the visual alert is unique, easily detected, and adequately contrasted when the data tag is in the handoff status. (Class II, Priority Action) (A-81-135)

Direct facilities whose airspace is configured in a manner similar to that of Atlanta Tower's (i.e., a "feeder" controller working two corridors which converge at the edge of the next controller's airspace), to review and establish procedures as necessary to provide altitude separation until longitudinal separation is assured. (Class II, Priority Action) (A-81-136)

Review the physical location of the various sectors' control positions to assess and optimize space utilization at Atlanta and in similar facilities nationwide to provide for direct communication and ease of coordination between closely interacting control positions. (Class II, Priority Action) (A-81-137)

Incorporate playback capability into the next generation of automated radar, both en route and terminal, so that actual problems involving a variety of traffic situations may be reviewed on the radar display for training purposes. (Class II, Priority Action) (A-81-138)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JAMES B. KING
Chairman

/s/ PATRICIA A. GOLDMAN
Member

/s/ G. H. PATRICK BURSLEY
Member

ELWOOD T. DRIVER, Vice Chairman, and FRANCIS H. McADAMS, Member, did not participate.

PATRICIA A. GOLDMAN, Member, filed the following concurring and dissenting statement:

I do not believe Safety Recommendation A-81-132 is justified. This special investigation had a very limited scope of inquiry, since it only examined the situation at Atlanta. The specific objectives of the recommendation were never identified. For example, it is not clear whether the proposed upgrade involved software or hardware modifications. Consequently, the cost implications of the recommendation are virtually unknown. This concerns me.

Certainly, "safety" is the Board's primary concern and we should not withhold a recommendation just because we haven't completed a cost benefit analysis of the recommendation. On the other hand, I do not believe the Board should continue to issue recommendations without some sort of recognition regarding their practicality relative to cost.

/s/ PATRICIA A. GOLDMAN
Member

September 24, 1981

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